Universidad Carlos III de Madrid

Bachelor Thesis

Bachelor's Degree in Aerospace Engineering

AIRBUS 320 Cabin Layout Passenger Arrangement Reconfiguration.

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Abstract

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This project was developed during a design engineering internship at SIRIUM AEROTECH and consists in the cabin layout passenger arrangement reconfiguration of an Airbus 320 aircraft in order to reduce the number of passenger seats from 174 to 162 and the final certification of the modification by means of EASA regulations.

First of all, there is an introduction explaining the goals of the project and its background, as well as an analysis of the socio-economic impact.

Secondly, it is found an inventory of all the materials involved in the project and the accomplishment instructions to carry out the whole modification.

Thirdly, a flammability test is performed in order to prove the fire resistance of materials that will be used to manufacture some parts needed for the change. After that, manufacturing instructions are presented.

Finally, the results obtained and the regulatory framework with the instructions for certifying the project are presented. This is followed by a time schedule and budget of the project and the conclusions.

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List of acronyms

All the acronyms found along the project are listed in this section, alphabetically ordered:

AFM: Aircraft Flight Manual.

AMC: Acceptable Means of Compliance.

APRB: Approval Sheet.

AMM: Aircaft Maintenance Manual.

AWM: Aircraft Wiring Manual.

CAM: Cabin Assignment Module.

CB: Conversion Bulletin.

CCL: Compliance Checklist.

CCL: Compliance Checklist.

CG: Center of Gravity.

CIDS: Cabin Intercommunication Data System.

CLAS: Classification Assessment.

CLAS: Classification Assessment.

CMM: Component Maintenance Manual.

DEU: Decoder/Encoder Unit.

DOA: Design Organization Approval.

DOP: Design Operating Pressure.

DWG: Drawing.

EASA: European Union Aviation Safety Agency.

ELT: Emergency Locator Transmitter.

ELT: Emergency Locator Transmitter.

EPA: European Part Approval.

ESF: Equivalent Safety Finding.

EWIS: Electrical Wiring Interconnection Systems.

FAA: Federal Aviation Administration.

FAP: Forward Attendant Panel.

HIC: Head Injury Criterion.

ICA: Instructions for Continued Airworthiness.

IPC: Illustrated Parts Catalogue.

JAR: Joint Aviation Requirements.

LOPA: Layout Passenger Arrangement.

MC: Mean of compliance.

MDL: Master Data List.

MDL: Master Data List.

MFCT: Manufacturing Instructions.

NSFSB: No Smoking/Fasten Seat Belt.

P/N: Part Number.

PA: Passenger Address.

PAX: Passengers / Persons / Occupants.

PBE: Personal Breathing Equipment.

PSU: Passenger Service Unit.

PTP: Programming and Test Panel.

SC: Special Condition.

STC: Supplemental Type Certificate.

TC: Type Certificate.

T/C: Tourist Class.

TCDS: Type Certification Data Sheet.

TP: Test Plan.

TR: Test Report.

TSO: Technical Standard Order.

WBM: Weight & Balance Manual.

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1 Introduction

This project provides instructions for accomplishing the main passenger cabin interior reconfiguration of the A320-233 aircraft MSN 3672 from its present configuration, as outlined in subsection 1.2, background of the project, to the configuration defined in DWG01 (see subsection 7.1), resultant 162 pax LOPA.

1.1 Goals of the project

The aim of this project is to solve the problem presented by an airline who bought an A320 aircraft in the secondhand marked and decided to change its LOPA configuration, which originally had a 174 pax arrangement, for allocating a lower number of passengers in order to make the new aircraft LOPA match with the configuration of the rest A320 airplanes of the company's fleet.

In that way, the solution requested by the airline is to reconfigure the current LOPA into a new one that accommodates a total of 162 passengers in a single tourist class configuration by removing 2 rows of seats, which implies a total of 12 seats. After that, the the project will be certified according to EASA standards.

In order to accommodate the new interior configuration, the following modifications are necessary:

- Removal of existing T/C seat assy's.
- Rearrangement of PSU/Spacer panels.
- Rearrangement of the Emergency Equipment.
- Carpet replacement.
- Curtain replacement.

The project contains all the necessary information to accomplish and certifying the modification proposed:

In section 2, it is found an inventory of all the materials involved in the project, both to be removed and added. Afterwards, section 4 shows the instructions to accomplish the modifications mentioned above step by step.

Then, in section 5, a flammability test is performed in order to prove the fire resistance of various materials that are going to be used for manufacturing some parts needed for the change. Later, once the materials have been tested, section 6 gives the instructions to manufacture them.

After that, section 7 presents the results of the modifications by a set of drawings and comments that show the new layout configuration.

Next, section 8 contains the regulatory framework of the project, as well as the instructions for certification.

In addition to that, in section 9 it can be bound the time organization of the project as well as the economic budget.

Finally, conclusions and references can be found.

1.2 Background of the project

The project arises from the problem presented by a company that bought an A320 aircraft in the secondhand market with the LOPA configured to allocate 174 passengers. The buying airline already owns an A320 fleet whose LOPA is configured to accommodate 162 passengers. Thus, a rearrangement was needed to unify the new bought airplane with the rest of the fleet.

In order to better understand how the aircraft LOPA was configured, figure 1, extracted from (2), shows the previous 174 pax arrangement, organized in a total of 29 rows.

Table below complements the information shown in the picture and indicates the relation between seat rows and seat assy's P/N. Take into account that each row is composed of two seat assy's with three seats each.

PART NUMBER	DESCRIPTION	QUANTITY	ITEM
3510A380A31-111	LH Seat Assy, TPL, IAT Narrow	1	1
3510A380A32-111	RH Seat Assy, TPL, IAT Narrow	1	2
3510A380A31-011	LH Seat Assy, TPL, STD	24	3
3510A380A32-011	RH Seat Assy, TPL, STD	21	4
3510A380A31-081	LH Seat Assy, TPL, No Back F/T	1	5
3510A380A32-081	RH Seat Assy, TPL, No Back F/T	1	6
3510A380A31-191	LH Seat Assy, TPL, IAT, No outbd Armrest, 22" Upright, No Rcln, No B/O	1	7
3510A380A32-191	RH Seat Assy, TPL, IAT, No outbd Armrest, 22" Upright, No Rcln, No B/O	1	8
3510A380A31-121	LH Seat Assy, TPL, IAT, No outbd Armrest, No B/O	1	9
3510A380A32-121	RH Seat Assy, TPL, IAT, No outbd Armrest, No B/O	1	10
3510A380A32-031	RH Seat Assy, TPL, Stretcher	3	11
3510A380A31-091	LH Seat Assy, TPL, Narrow	1	12
3510A380A32-071	RH Seat Assy, TPL, Narrow	1	13

Table 1: Relation of figure 1 items with seats P/Ns

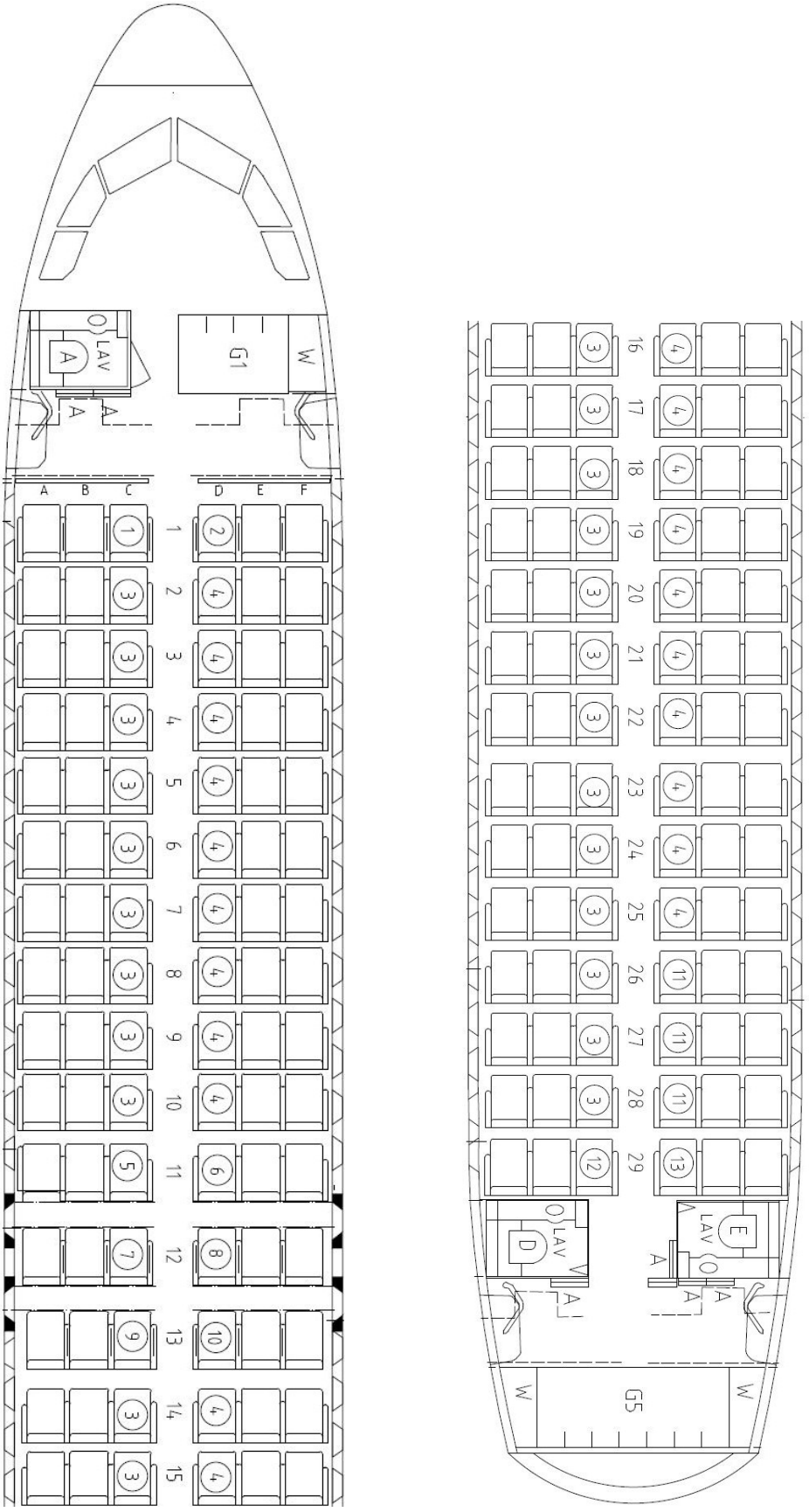


Figure 1: 174 pax configuration - rows 1 to 15 (left) and 16 to 29 (right) - extracted from (2).

1.3 Socio-economic environment

Nowadays, air transport is one of the most important industries, which is continuously increasing and contributing to the advances of the modern world.

Air transport services are getting more and more affordable to all types of social classes, nationalities and ages. This fact is making possible the rapid transport of approximately 11 millions of people per day, according to (32), as well of the movement of billions of dollars.

This industry plays a decisive role in the improvement of quality of life and living standards by facilitating tourism, which basically means connecting cultures, globalizing the society, internationalizing business and facilitating economic growth.

Airlines are an important sector within the air transport industry, whose efficiency is exponentially improving. In the last decades the concept of Low-Cost Carriers has emerged and rapidly growth since it can offers the accessibility of destinations to lower income residents. Airlines that works with this kind of flights usually operate with single-aisle aircraft, such as the A320 family.

The problem arises when the companies try to allocate the highest number of passengers possible to earn the maximum revenues with the lowest investment; this translates into uncomfortable and low quality flights.

1.3.1 Impact of the project

On the one hand, in the case of this project, the airline who bought the A320 aircraft prioritizes the quality of the flight and comfort of the passengers rather than offering a low-cost service.

On the other hand, the modification involved in this project entails the generation of approximately 7 employments: 4 of them will be destined to accomplish the LOPA rearrangement, 2 of them will be in charge of manufacturing carpets and curtains and the last employment, whose responsibilities will be personally assumed by me, is destined to carry out the flammability test, analyze its results and finally develop all the documentation that certifies the project.

1.4 Aircraft Manuals

The aircraft manuals give information about the maintenance of the airplane and its parts. When a modification is done, these manuals have to be supplemented, since the initial ones become obsolete. Each manual is applicable to an aircraft (or set of aircraft) in particular, so each airline must have all the manuals for its fleet updated.
The most important manuals are the following ones:

- AMM: It contains information necessary for service, repair, replacement, adjustment, inspection and verification of aircraft equipment and systems.
- CMM: It contains information related to the maintenance of aircraft equipment.
- IPC: It provides us with information about everything that we can find installed in the airplane (parts, screws, nuts, placards...), and in each section of it.
- AWM: It contains all diagrams of the electrical and electronic circuits of the airplane, which are sufficient to carry out a troubleshooting during the maintenance practices.

***NOTE:** In order to understand better how aircraft manuals are structured, the following information should be taken into account:

-*Numbering System:* Every manual is divided into chapters, using a three number code. The first number indicates the system of the airplane (engines, air conditioning, communication, placards and markings, etc), the second number indicates the sub-system (parts of the airplane) and the third number represents the subject or unit.

-*Effectivity Code:* In order to know which airplanes are effective to our projects, it necessary to consult the MSN (Manufacturing Serial Number).

-In order to identify any group of parts or equipment, the P/N (Part Number) must be used.

2 List of materials

2.1 Material to be removed

All removed material must be equipped with an identification tag for re-installation on this A/C or shipment to store. Installation material (fittings, screws, washers...) of all removed parts shall be collected and stored together with the equipment or identification of used P/N. This study does not include damaged parts replacement and "cabin touch up".

The materials indicated bellow need to be removed.

2.1.1 LOPA / Interior Arrangement Configuration

A total amount of four seat assemblies are going to be removed in order to reduce the LOPA from 174 to 162 passengers configuration. Each seat assy includes three seats allocated in a row (4 assemblies times 3 seats equals a total of 12 seats removed), as well as an armrest separating every seat of the set and a sliding mechanism coupled to the armrest.

Figure below, extracted from (2), shows two seat assemblies separated by the main aisle:

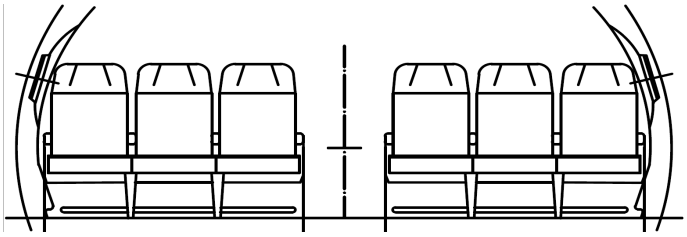


Figure 2: Two seat assemblies, (2).

On the other hand, another LOPA element to be removed is the CAM. As it is explained in (24), the CAM is a memory card which hold aircraft related data and software for specific customer layout. It is plugged into the PTP, located behind a hinged access door to the left of the FAP. Both PTP and FAP are part of the CIDS, which communicates with cabin, passengers and crew. They can control the following functions:

- Passenger reading lights
- Passenger call buttons
- Cabin lighting controls
- Cabin system monitoring/testing
- Passenger entertainment system
- Passenger address (PA)
- Automatic announcement and boarding music
- Cabin/Service interphone and calls

- EVAC signal
- Emergency light
- Door bottle pressure monitoring (either oxygen or escape slide?)
- Door proximity sensors (doors closed properly)
- Smoke detection
- Water and waste tank quantities

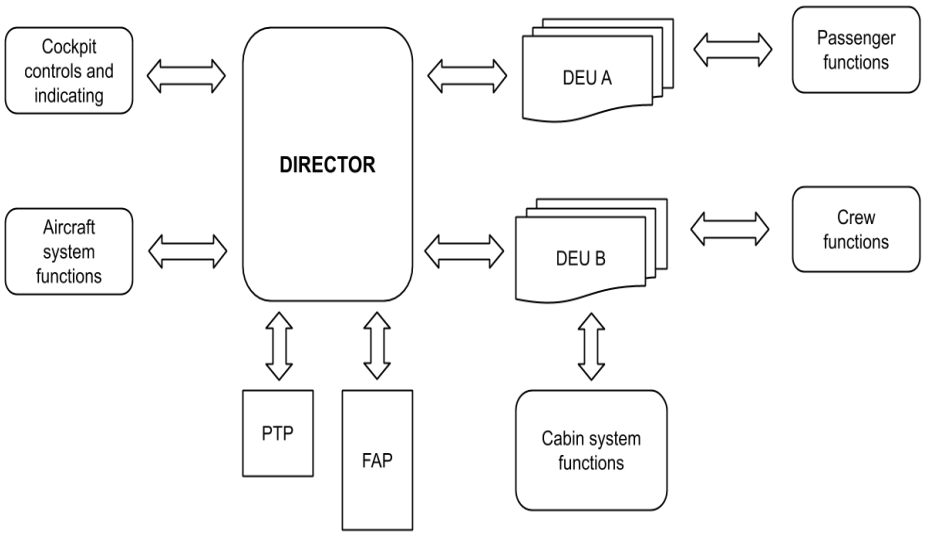


Figure 3: Cabin Intercommunication Data System (CIDS) Scheme.

Once it is clear the definition of both items, we are ready to discuss the exact seats to be removed. The following table summarizes the information of all seat assemblies that will not be useful anymore for the new configuration. For better understanding of applicable seat location/identification, see figure 1:

PART NUMBER	**DESCRIPTION**	**QTY**
3510A380A31-011	LH Seat Assy, TPL, STD	2
3510A380A32-011	RH Seat Assy, TPL, STD	1
3510A380A32-031	RH Seat Assy, TPL, Stretcher	1
Z054H003M051	CAM	1

Table 2: Seats to be removed.

NOTE: All removed seat assemblies are model nb. 3510A, type 380 Series, from Recaro.

2.1.2 PSU

PSU components are situated in the overhead panel, above the passenger seats, and can house several important comfort and service elements such as a flight attendant call button, a reading lamp, a loudspeaker, an air nozzle, optical display elements and emergency oxygen masks, which are automatically deployed in the hypothetical event of cabin depressurization. Those elements are integrated into a service column. Table below shows the PSU items that need to be removed from the aircraft's original configuration.

The following figure, extracted from (25) shows the essential PSU elements:

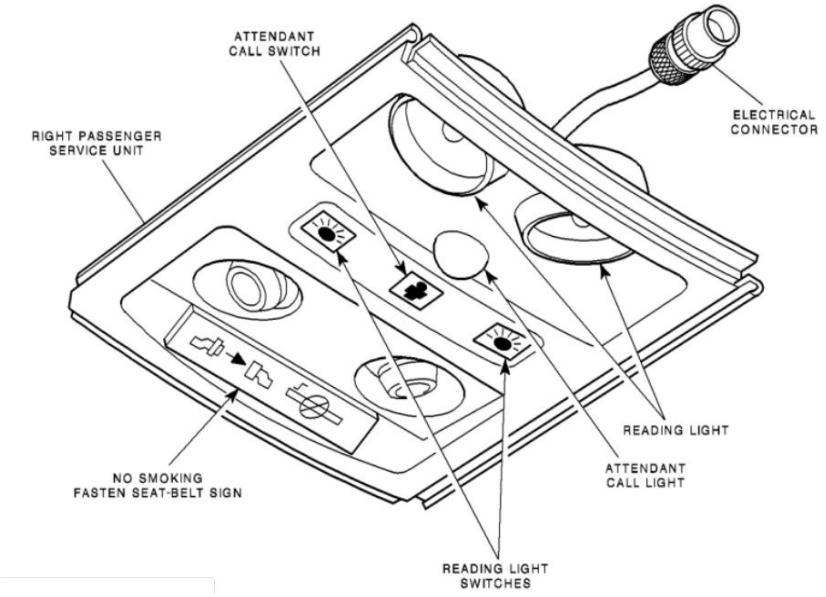


Figure 4: Passenger Service Unit parts, (25).

PART NUMBER	DESCRIPTION	QTY
Z315H0170123	Combi Panel Assy (NSFSB / Speaker / Reading Light / Row-Switch)	4
G1R124-25	4 Masks Container Assy – Chemical Oxygen (RH)	2
G1L124-25	4 Masks Container Assy – Chemical Oxygen (LH)	2
Z345H0011-006	Panel Assy – Gasper	4

Table 3: PSU items to be removed.

2.2 Material needed

2.2.1 LOPA / Interior Arrangement Configuration

The following table lists the seat assemblies to be re-installed into the aircraft in order to reach the new configuration. Notice that there is no change in P/Ns; refer to (10).

PART NUMBER	DESCRIPTION	QUANTITY	SEAT ROW
3510A380A31-111	LH Seat Assy, TPL, IAT Narrow	1	1
3510A380A32-111	RH Seat Assy, TPL, IAT Narrow	1	1
3510A380A31-011	LH Seat Assy, TPL, STD	22	2-9, 13-26
3510A380A32-011	RH Seat Assy, TPL, STD	20	2-9, 13-24
3510A380A31-081	LH Seat Assy, TPL, No Back F/T	1	10
3510A380A32-081	RH Seat Assy, TPL, No Back F/T	1	10
3510A380A31-191	LH Seat Assy, TPL, IAT, No outbd Armrest, 22” Upright, No Rcln, No B/O	1	11
3510A380A32-191	RH Seat Assy, TPL, IAT, No outbd Armrest, 22” Upright, No Rcln, No B/O	1	11
3510A380A31-121	LH Seat Assy, TPL, IAT, No outbd Armrest, No B/O	1	12
3510A380A32-121	RH Seat Assy, TPL, IAT, No outbd Armrest, No B/O	1	12
3510A380A32-031	RH Seat Assy, TPL, Stretcher	2	25-26
3510A380A31-091	LH Seat Assy, TPL, Narrow	1	27
3510A380A32-071	RH Seat Assy, TPL, Narrow	1	27
Z054H618J020	Cabin Assignment Module	1	-

Table 4: List of seats to be re-installed.

2.2.2 PSU

PSU distribution changes together with LOPA configuration and, in order to reach the 162 passengers arrangement, some items need to be added.

- **Added PSU Charts**

  An important part of the PSU are the infill panels, which ensure accurate spacing between the passenger service units and are in charge of allocating oxygen masks. Different measures of infill panels are presented depending on the seat.

PART NUMBER	DESCRIPTION	QUANTITY
D2527750301200	Infill Panel 6”	4
D2527750201200	Infill Panel 4”	22
A2157169420400	Hose (250 MM)	2
A2157169420200	Hose (400 MM)	4
A2157029120200	Cap	4

Table 5: PSU items to be added.

- **PSU/Spacer Panel Chart**

  Table below shows all the PSU items that need to be re-installed into the airplane, taking into account both added items and those that where already in the aircraft before the modification:

PART NUMBER	DESCRIPTION	QTY	COMENTS (MFG: EXCEPT AS NOTED)
Z315H0170123	Combi Panel Assy (NSFSB / Speaker / Reading Light / Row-Switch)	36	/652RH
Z315H0270123	Combi Panel Assy (NSFSB / Reading Light / Row-Switch)	2	/653RH
Z315H0370223	Combi Panel Assy, RH (Reading Light / Row-Switch)	16	/652RH
G1R124-25	4 Masks Container Assy – Chemical Oxygen (RH)	27	/ Container Assy must be equipped with 1ea. 117042-04 chemical oxygen generator and 4ea. 174095-96 Mask Assy
G1L124-25	4 Masks Container Assy – Chemical Oxygen (LH)	27	
Z345H0011-006	Panel Assy – Gasper	54	
D25277503012	Infill Panel 6”	6	
D25277502012	Infill Panel 4”	24	
D25277501012	Infill Panel 2”	18	
WJD350-20	Infill Panel 1”	11	
F25277577012	Adjustment Panel 8mm	4	
F25277576012	Adjustment Panel 16mm	4	
NPN	Adjustment Panel	4	Each adjustment panel consist of infill panel 1” (Qty. 2), adjustment panel 8mm (Qty. 1), and adjustment panel 16mm (Qty. 1)
D25285386012	Clamping Panel	2	
D25277524018	Partition Panel (RH)	1	
D25277524019	Partition Panel (LH)	1	
RDAV9843-02	Video, Retract Module (LH)	10	/ REF. / See Note 8
RDAV9844-02	Video, Retract Module (RH)	10	/ REF. / See Note 8
D925-90260-002	Med Outlet Panel (RH)	1	
A2157169420600	Hose (150 MM)	A/R	
A2157169420400	Hose (250 MM)	A/R	
A2157169420200	Hose (400 MM)	A/R	
A2157029120200	Cap	A/R	

Table 6: List of PSU items to be re-installed.

2.2.3 Emergency Equipment

All the emergency equipment needed to be rearranged according to the new configuration is summarized in the table below.

PART NUMBER	DESCRIPTION	QTY	MANUFACTURE
3505-151C-92	LIVE VEST – CREW	9	HOOVER (OR EQ. TSO-C13 VEST)
3505-151-92	LIVE VEST – PASSENGER	162	HOOVER (OR EQ. TSO-C13 VEST)
P2-07-0012-001	FLASHLIGHT	2	DME CORP (IN COCKPIT)
P2-07-0001-214	FLASHLIGHT	6	DME CORP (IN CABIN AT F/A STATION)
680-0040-000	CRASH AXE	1	THALES A.E.S.
A12SA	MEGAPHONE	2	FEDERAL SIGNAL CORP
LAI-8300JA	FIRST AID KIT	3	LEGEND AEROSPACE
FKK8-35KL	FIRE PROTECTION GLOVES	1 PAIR	BENNETT SAFETYWEAR LTD.
74-20	FIRE EXTINGUISHER - HALON 1211	1	MAIP (IN COCKPIT)
74-20	FIRE EXTINGUISHER - HALON 1211	3	TOTAL WALTER FEUERSCHUTZ (IN CABIN)
802300-14	PBE	5	AVOX
9700C1AF23AN	PORTABLE O2 BOTTLE W/ 1EA. MASK ATTACHED	5	AVOX (1EA. O2 MASK MUST BE CONNECTED TO EACH BOTTLE)
289-601-248	- O2 MASK	5	AVOX
995000	PSU RELEASE TOOL	4	B/E AEROSPACE
60128-101	SURVIVAL KIT	4	AIR CRUISERS
1153538-1	ELT, PORTABLE (EMERGENCY LOCATOR TRANSMITTER)	1	HONEYWELL
NPN	CREW – EMERGENCY DEMONSTRATION KIT	3	/ EACH KIT INCLUDES 1EA. DEMO LIFE VEST (P/N 3505-151D-92), 1EA. DEMO OXYGEN MASK (P/N 289-1001), AND 1EA. DEMO SEAT BELT (P/N 2011-1-511-8016)

Table 7: Emergency equipment to be re-installed.

2.2.4 Floor Covering

Floor covering is manufactured following the instructions of section 6 and subsequently installed by segments as explained in subsection 4.4. In order to determine the raw material to be used for carpets manufacturing, fire tests are performed as explained in section 5.
For better understanding of carpet segments listed below, see subsection 7.4 and DWG04.

PART NUMBER	**DESCRIPTION**	**QTY**
SA16-64M-25-01-A01/2	CARPET SEGMENT (33.2 x 59.4)	2
SA16-64M-25-01-A03	CARPET SEGMENT (34.1 x 23.0)	1
SA16-64M-25-01-A04	CARPET SEGMENT (296.5 x 18.4)	1
SA16-64M-25-01-A05	CARPET SEGMENT (216.4 x 18.4)	1
SA16-64M-25-01-A06	CARPET SEGMENT (267.1 x 18.4)	1
SA16-64M-25-01-A07	CARPET SEGMENT (58.5 x 32.4)	1
SA16-64M-25-01-B01/2	CARPET SEGMENT (285.4 x 16.1)	2
SA16-64M-25-01-B03/4	CARPET SEGMENT (284.9 x 17.6)	2
SA16-64M-25-01-B05/6	CARPET SEGMENT (295.0 x 18.7)	2
SA16-64M-25-01-B07/8	CARPET SEGMENT (20.9 x 18.7)	2
SA16-64M-25-01-B09/10	CARPET SEGMENT (286.5 x 16.1)	2
SA16-64M-25-01-B011/12	CARPET SEGMENT (286.1 x 17.6)	2
SA16-64M-25-01-B013/14	CARPET SEGMENT (214.9 x 18.7)	2
SA16-64M-25-01-B015/16	CARPET SEGMENT (288.6 x 16.7)	2
SA16-64M-25-01-B017/18	CARPET SEGMENT (288.1 x 17.6)	2
SA16-64M-25-01-B019/20	CARPET SEGMENT (267.1 x 18.7)	2
SA16-64M-25-01-B021/22	CARPET SEGMENT (23.0 x 18.7)	2
SA16-64M-25-01-B023	CARPET SEGMENT (35.5 x 3.6)	1
SA16-64M-25-01-B024	CARPET SEGMENT (36.7 x 9.2)	1
SA16-64M-25-01-C01	CARPET SEGMENT (58.0 x 58.9)	1
ABS5643AA29-18	SEAT TRACK – COVER	A/R
ABS5645AQ29-18	RACEWAY	30
Link 2318	ADHESIVE TAPE	A/R
ABS5648B100	DOUBLESIDE ADHESIVE TAPE	A/R

Table 8: List of carpet segments for installation.

2.2.5 Curtains

Curtains are manufactured following the instructions of section 6 and subsequently replaced as explained in subsection 4.4. In order to determine the raw material to be used for curtains manufacturing, fire tests are performed as explained in section 5.
For better understanding of curtains listed below, see subsection 7.5 and DWG05.

PART NUMBER	DESCRIPTION	QTY
SA16-64M-25-02-10	CURTAIN	1
SA16-64M-25-02-20	CURTAIN	1
SA16-64M-25-02-30	CURTAIN	1
DAN485-01	CURTAIN GLIDER	88

Table 9: List of curtains for installation.

3 Weight and Balance Study

Embodiment of this modification results in a change of the aircraft weight. It is the responsibility of the operator to re-weigh/calculate any weight and balance records updated to reflect new configuration according to document (9).

4 Accomplishment instructions

This part of the project is intended to give all the necessary instructions to accomplish the desired modification.

First of all, the aircraft must be prepared before the realization of the modification. It is necessary to take all the general safety measurements in order not to cause any harm neither the staff nor the equipment. After that, the aircraft must be put into maintenance configuration and electrically grounded. Finally, put the access platform in position at the passenger's door.

Once these initially steps have been carried out, it is possible to start defining the sections for implementing the proposed change:

1. Removal of the CAM.
2. Removal of passenger seats.
3. Installation of the CAM.
4. Carpet and Curtain Replacement
5. Installation of Passenger Seats, PSU Arrangement and Emergency Equipment.
6. Functional Checks.

The sections mentioned above must be carefully developed and its order must be strictly respected.

4.1 Removal of the CAM

Since the CAM contains specific data regarding layout configuration, it is important to remove it and re-install it later with the updated data for the modified layout. Otherwise, all CIDS functions would not work correctly.

The following instructions must be fulfilled:

1. Remove existing CAM with P/N Z054H003M051, by following the steps explained in (11, chapter 23-73-19)
2. Perform a general visual inspection for obvious damage of removed component and place identification tags hold for customer/operator disposition.

4.2 Removal of passenger seats

The following step is to remove all passenger seats, which are mounted on seat tracks and organized in assemblies including multiple seats together having a total seating area.

Thus, the following directions must be followed:

1. From seat row 1 through 11 and 14 through 29 remove all Tourist class seats from seat tracks, tag and retain in relative position for relocation.
2. Remove seat track covers and raceways. Tag and route to customer goods for customer disposition.
3. Remove seat-to-seat cables and seat-to-sidewall cables. Tag and save for re-installation.

   In order to correctly develop the previous three sections, it is necessary to refer to drawing VOI-A320-174, (2) for seats location/identification and refer to (11, chapter 25-21-41) for detailed procedures of passenger seats removal.
4. Locate the following seat assy's and route to customer goods for customer disposition:

PART NUMBER	DESCRIPTION	QTY	MFG
3510A380A31-011	LH Seat Assy, TPL, STD	2	RECARO
3510A380A32-011	RH Seat Assy, TPL, STD	1	
3510A380A32-031	LH Seat Assy, TPL, stretcher	1	

Table 10: Seat Assy's to be removed, located and routed to customer goods.

5. Clean and perform a detail visual inspection of all seat tracks. To do so refer to (11, chapters 53-21-00 / 53-31-00) for Inspection, cleaning and treatment of seat track.
6. Perform a visual inspection for obvious damage of all removed seats, with special attention to seat belts, seat belt attach fittings and seat legs seat track fittings. Finally place identification tags and hold for customer disposition on all items removed from the aircraft. Verify all seats have Technical Standard Order (TSO) identification ID plates, all seat belts have readable TSO-C22 tags. Refer to (11, chapter 25-21-00) for inspection procedures.

As issued by the FAA, a TSO is a minimum performance standard for specified materials, parts, processes, and appliances used on civil aircraft. It is explained in (27) that TSO-C22 is the standard referred to safety seat belts , which stipulates that each safety belt must be equipped with an approved metal to metal latching device and must be able to hold the minimum tensile load. Airworthy, one person type-certificated belts should be able to withstand a tensile load of 525 pounds and most one person TSO belts are rated for 1,500 pounds.

4.3 Installation of CAM

Once the new LOPA configuration has been chosen and designed, the CAM with P/N Z054H618J020, containing updated specified data has to be re-installed. Refer to (11, chapter 23-73-19) for CAM installation instructions.

4.4 Carpet and curtain replacement

Carpets are designed according to seat tracks layout, so when a new design is done, carpet and curtains must be also replaced.

The following steps must be followed:

1. Replace main cabin carpet. Fabricate carpet segments and install them as shown in DWG04 (see section 7.4).

   Note: Refer to (14) for general notes and details and verify that all of them are met.

   Refer to (11, chapter 25-28-41) for detailed procedures of carpet removal/installation instructions.

2. Replace curtain assy's located between Fwd. RH Galley G1 and Fwd. RH Windscreen assy, and between aft Lavatories: Fabricate curtains and install them as shown in DWG05 (see section 7.5.

   For general notes and details, refer to (13) and verify that all of them are met.

   Refer to (11, chapter 25-26-41) for detailed procedures of curtain removal/installation instructions.

4.5 Installation of passenger seats, PSU arrangement and emergency equipment.

Now, installation of the new cabin arrangement configuration must be carried out. The following steps must be followed:

1. Install T/C passenger seats in the locations shown in DWG01 (see section 7.1) and verify that all drawing notes and details are met.

   - Reinstall Seat-to-Seat cables. All seat cables that are not used must be route to customer goods.

- New seat track covers may be fabricated using section cover material with P/N ABS5643AA29-18; trim length as required.

- New raceways may be fabricated using section cover material with P/Ns ABS5645AQ29-18, ABS5642AL29-18, ABS5644AA29-18, or ABS5642AU29-18; trim length as required.
Install them using adhesive tape of P/N Link 2318 B.
Refer to (11, chapter 25-21-41) for detailed procedures of passenger seats installation.

2. Verify that all seats have TSO identification ID plates (TSO C-127a).
Verify that all seat cushions are tagged showing compliance with (19, Paragraph 25.853).
Verify that all seat belts have readable TSO-C22 tags (or TSO-C114 for torso restraint systems).

3. Rearrange PSU and utilities panels as shown in DWG02 (see section 7.2).
Verify that all drawing notes and details are met. Tag and route any PSU's and/or spacer panels not used in reconfiguration to customer goods.
Refer to DWG02 for applicable AMM chapters on PSU panels removal/installation instructions.

4. Verify/Install cabin emergency equipment as shown in DWG03 (see section 7.3).
Verify all drawing notes and details are met.

5. Verify that the floor emergency path lights clear passenger seat baggage restraint bars. Adjust as required to comply with DWG01 (see section 7.1). Refer to (11, chapter 33-51-21) for photo-luminescent floor proximity light removal instructions.

6. Install seat row placards to comply with LOPA configuration shown in DWG01.
Refer to (11, chapter 11-32-25) for interior placards maintenance practices.

4.6 Functional Checks

Finally, in order to test that the modification has been successfully carried out and everything is working properly and as expected, some functional checks are done.

1. Adjust and check passenger reading lights.
Refer to (11, chapter 23-73-64) for passenger reading lights adjustment and operational test.

2. Perform operational test of passenger call lights.
Refer to (11, chapter 23-73-00) for passenger call system operational test.

3. Perform operational test of the general illumination.
Refer to (11, chapter 33-21-00) for the general illumination operational test.

4. Verify drop location of passenger oxygen masks (refer to (11, chapter 35-21-41)) and perform operational test of manual of manual mask release of passenger oxygen system (refer to (11, chapter 35-23-00)).
Refer to DWG01 (see section 7.1) for detail of oxygen mask drop allowable area.

5. Verify visibility of all passenger and flight attendant NSFSB signs and perform operational test.
Refer to (11, chapter 23-73-00) for cabin signs operational test.

6. Verify all emergency lighting, interior and exterior, and perform operational test. Refer to (11, chapter 33-51-00) for cabin signs operational test.
7. Verify Passenger Address (PA) system and perform operational test as explained in (11, chapter 23-73-00)
8. Perform Verification of Speech Intelligibility Test of PA system per (11, chapter 23-73-00)
9. Verify that all interior signs and placards are installed and visible:
   (a) Exit signs at doors and ceiling must be visible from all passenger seats.
   (b) Life vest placards indicating 'LIFE VEST UNDER SEAT'.
   (c) Curtain placards 'CURTAINS TO BE OPEN FOR TAKEOFF AND LANDING'.
   (d) Miscellaneous interior door placards 'DOORS MUST BE CLOSED AND LATCHED DURING
   (e) TAKEOFF AND LANDING'.
   (f) 'NO SMOKING', 'FASTEN SEAT BELT' while seated placards or lighted signs visible from all passenger and flight attendant seats.
   (g) 'NO SMOKING' placard on both sides of lavatory doors.
   (h) Smoke detector placard in all lavatories: *'Federal law provides for a penalty of up to $2,000 for tampering with the smoke detector installed in this lavatory.'*
   (i) No cigarette disposal placard on waste compartments in all lavatories.
   (j) Exit doors and slide placards for operation and location.
   (k) Emergency equipment placards at all equipment locations.
   (l) Weight limit placards in all overhead bins and cabin storage compartments.
10. Refer to (9) in order to verify that aircraft was weighed and weight and balance records updated to reflect new configuration.

5 Vertical Testing

Tests are performed in order to provide the proof of compliance with some legal paragraphs of interest and requirements. In this case, paragraph 25.853, Compartment Interiors (see section 8 for better understanding), will be demonstrated.

As indicated in (26), vertical testing provides a method of quantifying the ability of products and materials, in a vertical orientation, to withstand exposure to high temperatures. The fire resistance properties of a material provide extensive information to assess its behaviour.
Fire resistance tests can be used to prove materials such as floor covering, textiles, seat cushions, padding, leather, trays and galley furnishings, electrical conduit, air ducting, joint and edge covering, baggage compartments, moulded and thermoformed parts and air ducting joints, among others. They must be self- extinguishing when vertically tested.

5.1 Test Plan

For this project, a 12 seconds vertical test was carried out according to (23), which states the following:

"Interior ceiling panels, interior wall panels, partitions, galley structure, large cabinet walls, structural flooring, and materials used in the construction of stowage compartments (...) must be self-extinguishing when tested vertically (...). The average burn length may not exceed 6 inches and the average flame time after removal of the flame source may not exceed 15 seconds. Drippings from the test specimen may not continue to flame for more than an average of 3 seconds after falling."

Test has been performed at Sirium Aerotech facilities and (3) has been used as guide.

Since carpets and curtains for the new configuration are going to be manufactured (see section 6), a material needs to be chosen for them.

The materials to be proved were the following ones:

- Carpet P/N: BWW69/2
- Curtain Fabric P/N: 2759LS700

If these materials pass the test, then they will be used for the manufacturing of carpets and curtains.

5.1.1 Specimen conditioning and configuration

Specimens must be conditioned to 21.11 $\pm$ 3°C (70 $\pm$ 5°F) and at 50% $\pm$ 5% relative humidity until moisture equilibrium is reached or for 24 hours. Each specimen must remain in the conditioning environment until it is subjected to the flame.

Materials must be tested either as a section cut from a fabricated part as installed in the airplane or as a specimen simulating a cut section, such as a specimen cut from a flat sheet of the material or a model of the fabricated part. The specimen may be cut from any location in a fabricated part; however, fabricated units, such as sandwich panels, may not be separated for test.

Except as noted below, the specimen thickness must be no thicker than the minimum thickness to be qualified for use in the airplane. Test specimens of thick foam parts, such as seat cushions, must be 13 mm (0.5 inch) in thickness.

Both the warp and fill direction of the weave must be tested to determine the most critical flammability condition. Specimens must be mounted in a metal frame so that the two long edges and the upper edge are held securely during this vertical test.

The exposed area of the specimen must be at least 50 mm (2 inches) wide and 31 cm (12 inches) long, unless the actual size used in the airplane is smaller. The edge to which the burner flame is applied must not consist of the finished or protected edge of the specimen but must be representative of the actual cross-section of the material or part as installed in the airplane.

5.1.2 Definitions

1. Ignition Time: it is the length of time the burner flame is applied to the specimen. It will be 12 seconds for this test.
2. Flame Time: it is the time in seconds that the specimen continues to flame after the burner flame is removed from beneath the specimen. Surface burning that results in a glow but not in a flame is not included. It is referred as "Extinguishment Time" in tables 11 and 12.
3. Drip Flame Time: it is the time in seconds that any material continues to flame after falling from the specimen to the floor of the chamber. If no material falls from the specimen, the drip flame time is reporter to be 0 seconds, and the notation "No Drip" is also reported. If there is more than one drip, the drip flame time reported is that of the longest flaming drip. If succeeding flaming drips reignite earlier drips that flamed, the drip flame time reported is the total of all flaming drips.
4. Burn Length: it is the distance from the original specimen edge to the farthest evidence of damage to the test due to the area's combustion including areas of partial consumption, charring, or embrittlement but not including areas sooted, stained, warped, or discolored nor areas where material has shrunk or melted away from the heat.

5.1.3 Apparatus

Tests must be conducted in a draught-free cabinet in accordance with Federal Test Method Standard 191 Model 5903 (revised Method 5902) for the vertical test, (available from the General Services Administration, Business Service Centre, Region 3, Seventh & D Streets SW., Washington, DC 20407). Specimens, which are too large for the cabinet, must be tested in similar draught-free conditions.

5.1.4 Vertical Test Procedure

A minimum of three specimens must be tested and results averaged. For fabrics, the direction of weave corresponding to the most critical flammability conditions must be parallel to the longest dimension.

Each specimen must be supported vertically. The specimen must be exposed to a Bunsen or Tirril burner (both type of burners have air and gas controls but the first one is less refined) with a nominal 9.5 mm ($\frac{3}{8}$-inch) I.D. tube adjusted to give a flame of 38 mm ($1 + \frac{1}{2}$ inches) in height.
The minimum flame temperature measured by a calibrated thermocouple pyrometer in the centre of the flame must be 843°C (1550°F).
The lower edge of the specimen must be 19 mm ($\frac{3}{4}$-inch) above the top edge of the burner.
The flame must be applied to the centre line of the lower edge of the specimen.
Flame time, burn length, and flaming time of drippings, if any, may be recorded. The burn length must be measured to the nearest 2.5 mm (tenth of an inch).

Limit values for average burn length, flame time and drip time were already defined at the beginning of this section according to (23).

5.2 Test Results

Once the procedure explained before was applied, measurements for the vertical test are recorded and compared to the maximum possible value in order to know if the materials tested are usable or not.

5.2.1 Measurements for Carpets Material

The tested material with P/N BWW69/2 and nb. of batch 200715 is 100% made of wool.

	Run 1	**Run 2**	**Run 3**	**Average**	**Limit**
Burn Length (mm)	36	50	44	43.3	150
Extinguishment Time (sec)	1	1	1	1.0	15
Drip Flame Time (sec)	0	0	0	0	5

Table 11: Test Results for P/N BWW69/2

The material detailed above **PASSED** the requirements of (23) with respect to flammability, since average measurements are below the limit.

No drip is presented.

5.2.2 Measurements for Curtains Material

The tested material with P/N 2759LS700 and nb. of batch PR002672001 is 100% made of polyester.

	Run 1	Run 2	Run 3	Average	Limit
Burn Length (mm)	80	60	50	63	150
Extinguishment Time (sec)	0	0	0	0	15
Drip Flame Time (sec)	0	0	0	0	5

Table 12: Test Results for P/N 2759LS700

The material detailed above **PASSED** the requirements of (23) with respect to flammability, since average measurements are below the limit.

6 Manufacturing Instructions

This section provide the necessary instructions to manufacture carpets and curtains. Every manufactured item needs to be endowed with a part number so, in this case, carpets will have P/N SA16-64M-25-01-XXX while curtains will have P/N SA16-64M-25-02-XX, where "X" indicates the number of item (see tables 14 and 15 for better understanding).
The manufacturer must supply the material shown in section 6.1, Material Information.

6.1 Material Information

In order to accomplish the correctly manufacturing of the parts mentioned above, the material indicated in the following chart is required:

Material	Description	QTY per part
BWW69/2	Carpet	A/R
N014129-36221	Yarn	A/R
N044103-36221	Synthetic yarn	A/R
ABS5679AA42-7	Linning Tape	A/R
2759LS700	Curtain Fabric	A/R
VT295E-SIZE-E	Curtain Yarn	A/R
DAN168D03	Stitch Twin	A/R

Table 13: Material needed for manufacturing of carpets and curtains.

6.2 Tooling

This manufacturing instructions can be performed with standard textile manufacturing tooling. No special tools are required.

6.3 Accomplishment Instructions

First of all, it is necessary to take all the general safety measurements in order not to cause any harm neither the staff nor the equipment. The manufacturing instructions will be applied ass follows:

1. **Manufacturing of carpets P/N SA16-64M-25-01-XXX**

   (a) Manufacture the carpets with P/N SA16-64M-25-01-XXX according to measures indicated in drawing DWG04.

   Use the following raw materials*:

   - Carpet P/N: BWW69/2
   - Yarn P/N: N014129-36221
   - Synthetic Yarn P/N: N014129-36221
   - Linning Tape P/N: ABS5679AA42-7

   *Materials proposed above has been successfully proved by vertically testing as explained in section 5.

   The equivalence between carpets P/N and items shown in DWG04 is exposed in the table below:

Carpet P/N	Drawing Item	QTY per A/C
SA16-64M-25-01-A01/2	-A01	2
SA16-64M-25-01-A03	-A03	1
SA16-64M-25-01-A04	-A04	1
SA16-64M-25-01-A05	-A05	1
SA16-64M-25-01-A06	-A06	1
SA16-64M-25-01-A07	-A07	1
SA16-64M-25-01-B01/2	-B01	2
SA16-64M-25-01-B03/4	-B03	2
SA16-64M-25-01-B05/6	-B05	2
SA16-64M-25-01-B07/8	-B07	2
SA16-64M-25-01-B09/10	-B09	2
SA16-64M-25-01-B11/12	-B11	2
SA16-64M-25-01-B13/14	-B13	2
SA16-64M-25-01-B15/16	-B15	2
SA16-64M-25-01-B17/18	-B17	2
SA16-64M-25-01-B19/20	-B19	2
SA16-64M-25-01-B21/22	-B21	2
SA16-64M-25-01-B23	-B23	1
SA16-64M-25-01-B24	-B24	1
SA16-64M-25-01-C01	-C01	1

Table 14: Relation between P/Ns and carpet sections in DWG04 (see section 7.4)

.

NOTE: Carpet segment P/N SA16-64M-25-01-B19/20 can be split into 2 carpet segments of 271.27 x 47.50 cm (160.8 x 18.7 in) and 270.00 x 47.50 cm (106.3 x 18.7 in).

(b) Perform EPA marking in manufactured parts using permanent ink. Perform it in a non visible place of the carpet with a label of maximum 75 x 75mm (3 x 3 in). The label must include the following information:

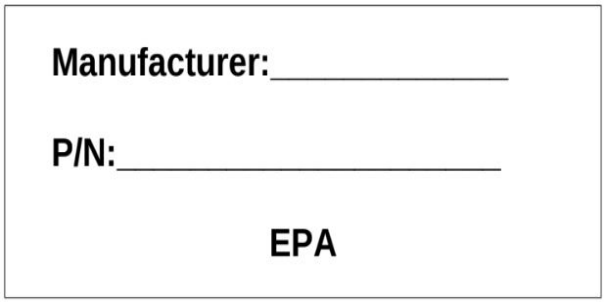


Figure 5: European Part Approval (EPA) Marking

In order to understand why EPA markings are necessary, let's follow the explanation of (21):

"To comply with EASA Part-21, Subpart D, 21.A.109, Subpart E, 21A.118A (b) and Subpart M, 21A.451(a) and (b), it is the obligation of the respective Holders of a Minor Change Approval, a STC, or a Major Repair Design Approval, to specify the required markings, including EPA letters as applicable, in their Design (read, 'Approved Data'), according EASA Part-21, Subpart Q.

Subpart Q, 21.A.804(a), and related GM, require proper identification of each Part and Appliance that is designed or redesigned, including parts designed to be incorporated in repairs (21A.451), by 'permanent and legible marking' hereof, and is applicable for Design Organisations and Manufacturers.

[...]Each interchangeable or removable Part or Appliance that is manufactured in accordance with a design issued by the Design Organisation, shall be permanently and legibly marked according to 21.A.804. The EPA marking was introduced in 2004; this was done to clearly identify any 'not original' Part, (which means any Part or Appliance not designed by the TC- or ETSO- Approval Holder), as a trigger for Maintenance Organisations and Accident or Incident investigators, in the light of Continuing Airworthiness. The intention was certainly not to require adding of the letters 'EPA' to mark repairs. In this context, EPA marking only applies to the new designed and manufactured parts to be incorporated in the repair. Especially where repairs have an impact on interchangeability, identification of incorporated new Parts is very important, and DO Procedures should address this item."

2. **Manufacturing of curtains P/N SA16-64M-25-02-XX**

(a) Manufacture the curtains with P/N SA16-64-25-02-XX according to measures indicated in DWG05.

Use the following raw materials*:

- Curtain Fabric P/N: 2759LS700
- Yarn P/N: VT295E-SIZE-E
- Stitch Twin P/N: DAN168D03

*Materials proposed above has been successfully proved by vertically testing as explained in section 5.

The equivalence between curtains P/Ns and items shown in DWG05 is specified in the following table:

Carpet P/N	Drawing Item	QTY per A/C
SA16-64M-25-02-10	-10	1
SA16-64M-25-02-20	-20	1
SA16-64M-25-02-30	-30	1

Table 15: Relation between P/Ns and curtain items in DWG05 (see section 7.5)

.

(b) Perform EPA marking in manufactured parts using a 100% nylon or 100% polyester label.

Perform it in a non-visible place of the curtain with a label of maximum 75 x 75 mm (3 x 3 in). The label must include information shown in figure 5.

6.4 Manpower

Finally, when all the procedures are clear, it is possible to appraise the time needed to perform the manufacturing. The table below shows an estimate of the section-hours necessary to accomplish the instructions for each manufactured part. This estimate is for direct labor only, done by an experienced crew. Adjust the estimate with operator section-hour data if necessary. The estimate does not include lost time. These are some examples of lost time:

- Time to adjust to the workplace
- Time to schedule the work
- Time to examine the work
- Time to make the parts
- Time to find the tools

section	section-Hours
Manufacturing of curtains	4 man-hour
Manufacturing of carpets	20 man-hour
TOTAL FOR EACH AIRPLANE	24 man-hour

Table 16: Estimated man-hours for manufacturing.

7 Results

After applying the modification, a final configuration of 162 pax is reached. in addition to the decrease in the number of seats, there is also a rearrangement of PSU and spacer panels, emergency equipment, carpets and curtains.

The final results for all these rearrangements are going to be shown by AutoCAD drawings.

AutoCAD is a Computer-Aided Design (CAD) software application used in architecture, engineering and manufacturing to assist in the preparation of blueprints.

Take into account that, unless otherwise specified, dimensions are in inches, no manual changes are allowed and drawings are not scaled. General tolerances are $\pm \frac{1}{64}$ fractional, $\pm$ 1 decimal and $\pm$ 3^{o} angular.

7.1 162 pax Seats Arrangement Configuration

This section shows the resultant 162 passenger seats arrangement configuration by a set of four drawings, DWG01-X (where "X" takes the values 1 and 2), is presented bellow and the following notes, which must be carefully read for better understanding, refer to it:

1. FL prefix on note numbers below indicates drawing flag note.
2. All seats must comply with TSO-C127, NAS809, FAR 25.853 and contain FAA approved under-seat baggage restraint bars, seats must be approved for installation on Airbus 320-200 series aircraft and be placarded for the following minimum inertia static load factors: 9.0g FWD, 1.5g AFT, 5.4g UP, 8.6g DOWN and 1.5g SIDE (see 2 for better understanding of load factors).
3. (FL) The projected over-wing exits openings must be unobstructed and there must not be interference in opening the exit hatch by seat backs in the most adverse position, seat backs recline and break over must be restricted as necessary to prevent encroachment into the passageway and/or interference with opening the exit hatch.

   A placard must be installed on each over-wing exit hatch, readable by all passengers seated adjacent to and facing the passageway to exit, stating the weight of the hatch.

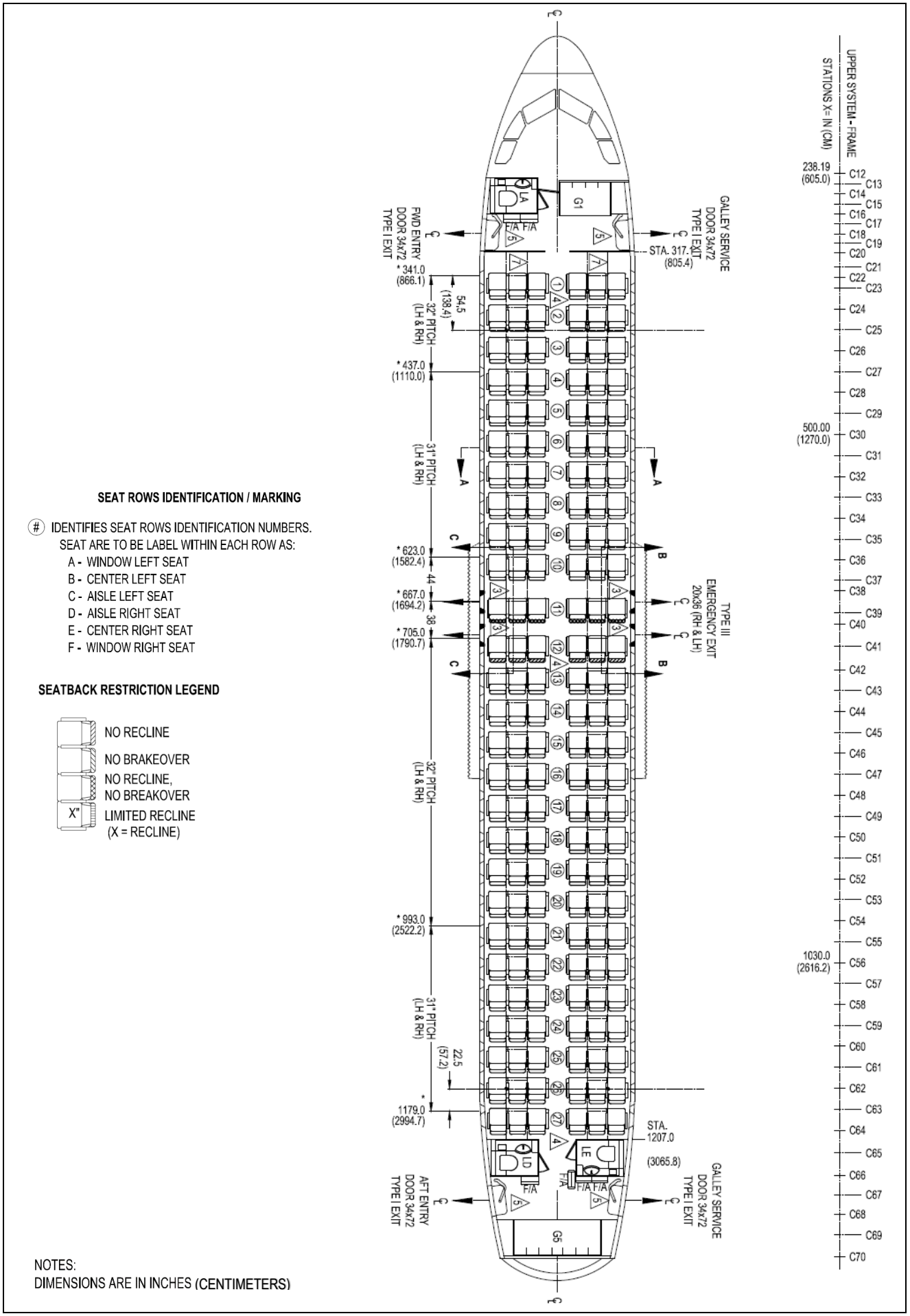
   A placard must be installed on each over-wing exit hatch, readable by all passengers seated adjacent to and facing the passageway to exit, reading the following (or equivalent, an illustration may be used instead of text, refer to (11, Chapter 52-21-11, figure 52-21-11-991-00100-a) for hatch illustration and operation procedures):

   "Unlatch hatch by pulling upper handle inward and downward, remove hatch by rotating the top of the hatch inward and lifting the hatch upward while holding the hatch by the upper and lower handles with both hands, place hatch upright on the adjacent seat against the seat back".
4. (FL) Main aisle width must not be less than 15 inches (38 cm) below 25 inches (63.5 cm) height, 20 inches (50.8 cm) above 25 (63.5 cm) inches height.
5. (FL) Aisle width leading to all Type I* exits must not be less than 20 inches (50.8 cm).

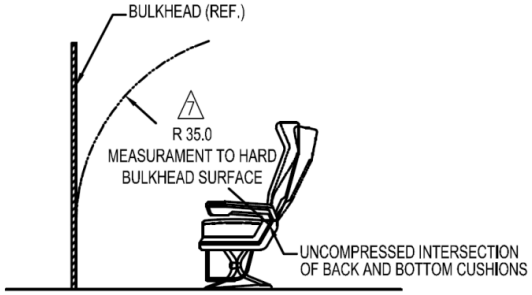
*Emergency exit types can be consulted at (19, Paragraph 25.807):

"-Type I. This type is a floor-level exit with a rectangular opening of not less than 24 inches wide by 48 inches high, with corner radii not greater than eight inches.
-Type III. This type is a rectangular opening of not less than 20 inches wide by 36 inches high with corner radii not greater than seven inches, and with a step-up inside the airplane of not more than 20 inches. If the exit is located over the wing, the step-down outside the airplane may not exceed 27 inches."

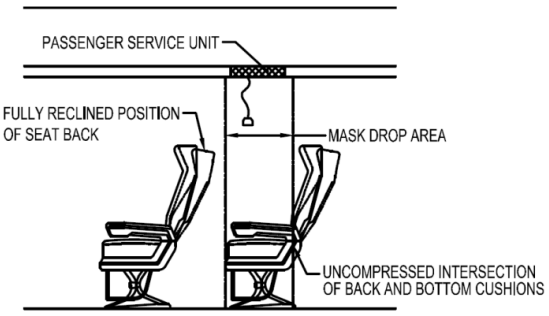
6. (FL) All seat locations are given by fuselage station location of the forward legs studs in the locked position with a tolerance of $\pm \frac{3}{8}$ inches, seat locations fuselage stations are indicated with "*" in the drawing.
7. (FL) Minimum distance from bulkheads to forward face of seat backrest directly aft of the bulkhead is 35 inches (89 cm).
8. Repitch PSU's as required to match new seating arrangement, refer to DWG02 (see section 7.2 for PSU/Spacer panel locations and refer to (11) for PSU/Spacer panels removal/installation instructions.
9. Ensure that the floor proximity emergecy escape path marking system is not blocked by the seats in the new positions and that emergency exit clues correspond to the aisle leading to the Type III* exists, make adjustments as required. Refer to (11, chapter 33-51-00).
10. No new interior items are introduced in this modification except for the items shown in the tables of this document. All other interior items were already existing and assumed to be approved under previous configurations.For instructions for continued airworthiness of passenger seats, refer to (10).
11. Aircraft must be weighed after cabin reconfiguration to determine new aircraft weight and C.G. location. Revise aircraft weight and balance records to reflect new configuration and refer to (9) for weight and balance procedures.



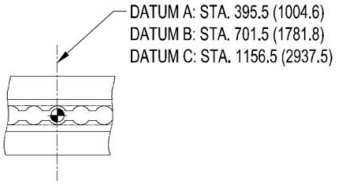
DWG01-1: Resultant 162 pax LOPA.



REQUIRED BULKHEAD CLEARANCE
(SCALE: NONE)

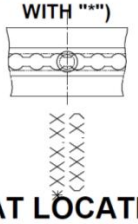


TYPICAL PSU LOCATION
(SCALE: NONE)

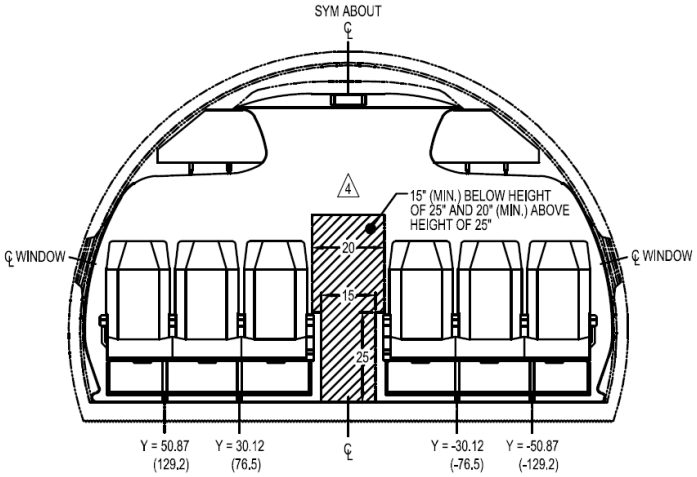


SEAT LOCATION INFORMATION
(TYP ALL SEAT TRACKS)
(SCALE: NONE)

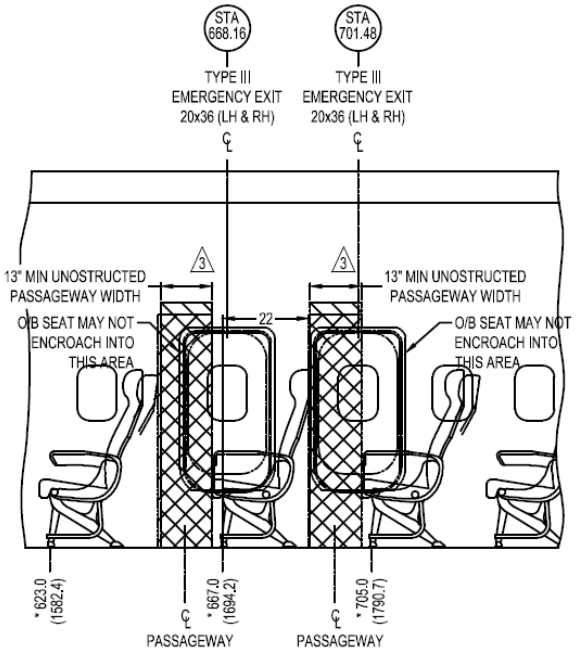
6
ALL SEAT LOCATION ARE GIVEN TO THE CENTERLINE OF FRONT LEG FTG (SEAT LOCATIONS ARE IDENTIFIED WITH "*")



SEAT LOCATION INFORMATION
(SCALE: NONE)



6 ABREAST SEATING (TYP.)
MINIMUM AISLE WIDTH TO BE MAINTAINED THROUGHTOUT THE CABIN
VIEW LOOKING AFT



SECTION A-A (SHOWN)
SECTION B-B (OPP.)

NOTES:
DIMENSIONS ARE IN INCHES (CENTIMETERS)

DWG01-2: Seat Details.

7.2 PSUs Layout

This section gives information about PSU layout for the resultant LOPA configuration. To gather all the information, a set of four drawings, DWG02-X (where "X" goes from 1 to 4), is presented bellow and the following notes, which must be strictly followed, refer to them:

1. Refer to the following (11) sections for the described operations:
   (a) Removal/installation of gasper panels per (11, chapter 21-24-19, section 21-24-19-000-001) for removal and (11, chapter 21-24-19, section 21-24-19-400-001) for installation.

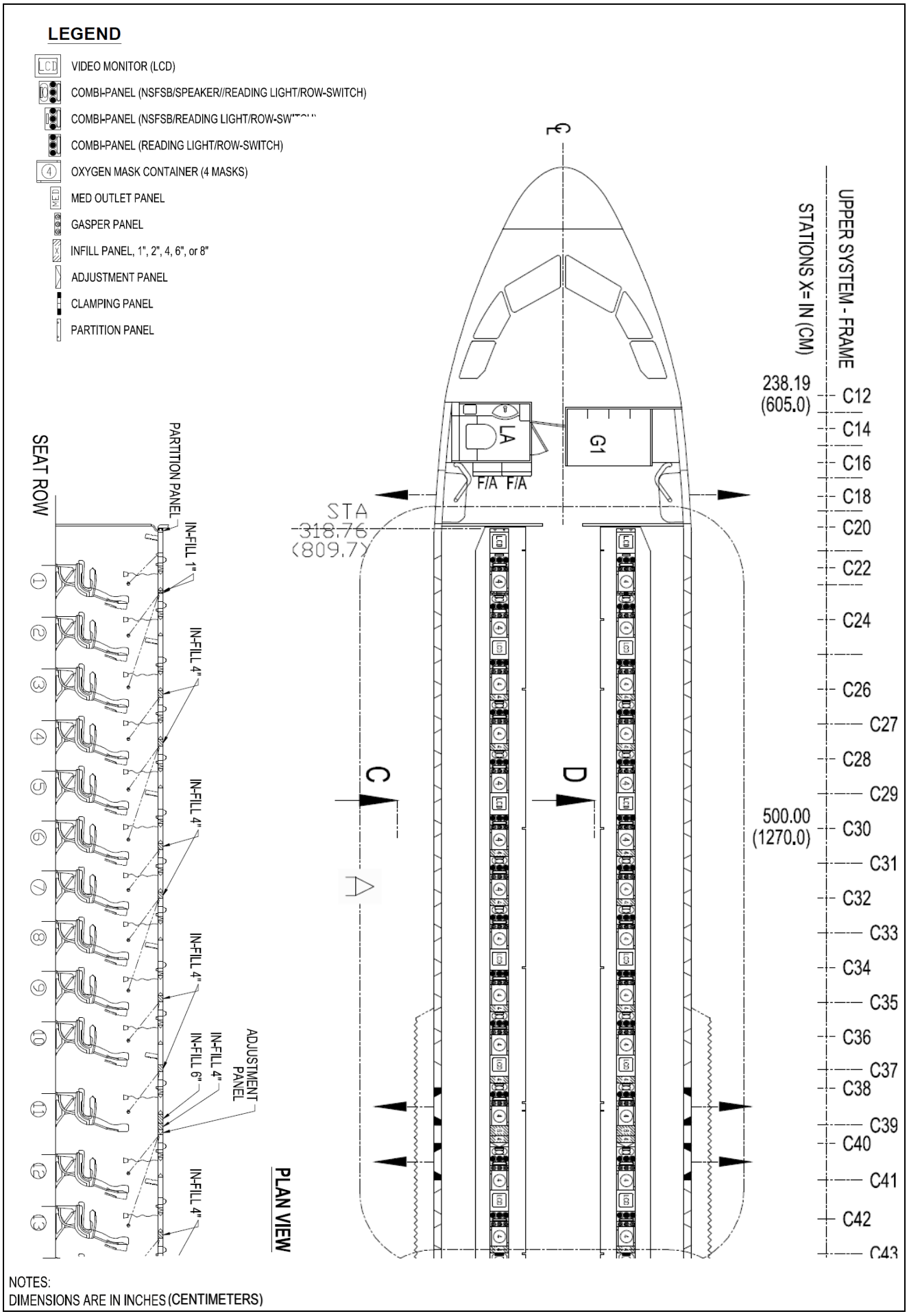
   -Connect each gasper panel plenum to the air distribution manifold adjacent outlet with hose P/N A2157694206 (150mm), A2157694204 (250 mm) or A2157694202 (400 mm) as required, push hose firmly onto connection until it meets the end stop.

   -Install cap P/N A21570291202 in all gasper panel plenum outlets not used.

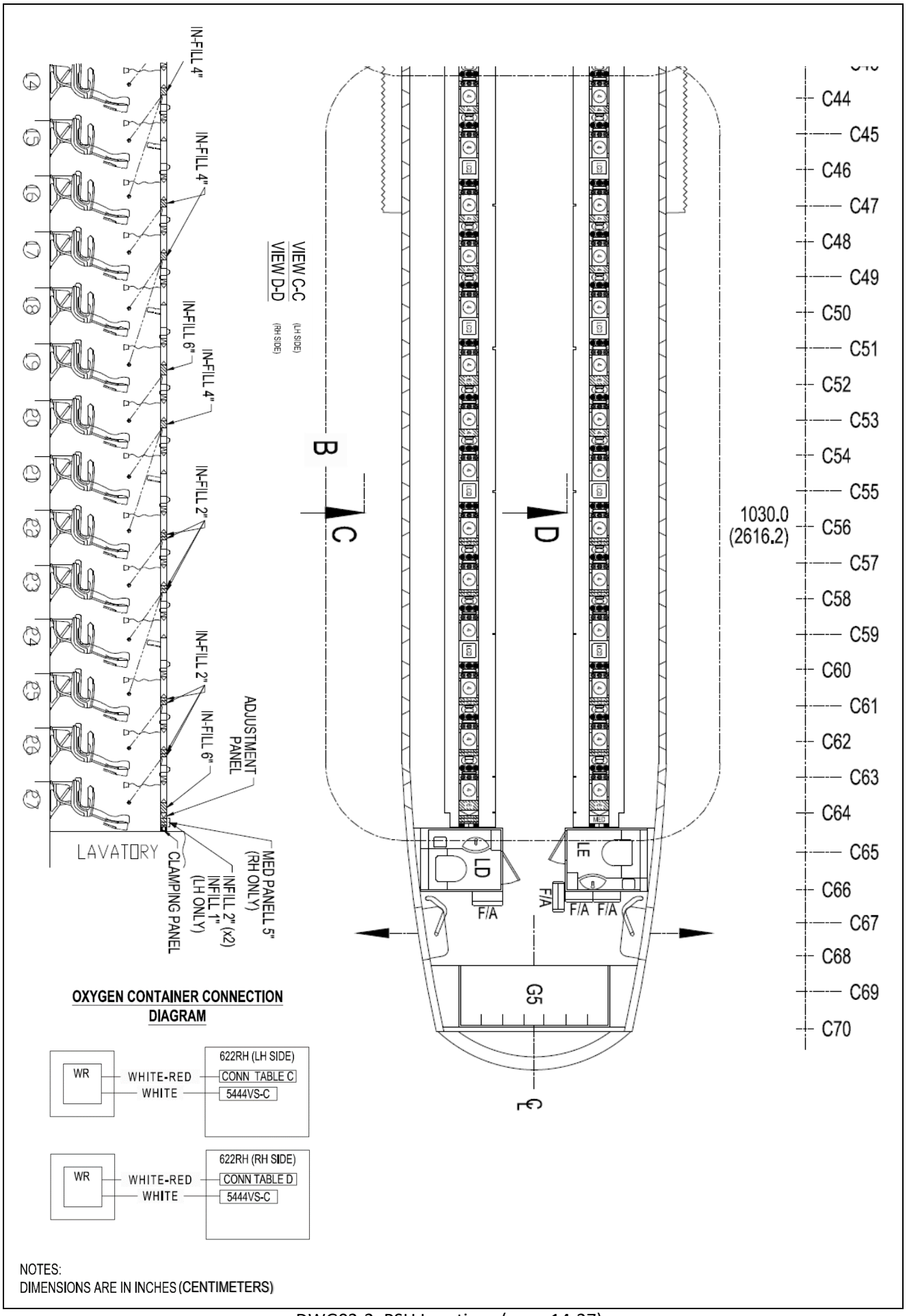
   (b) Removal/installation of oxygen containers per (11, chapter 35-21-41, section 35-21-41-000-001) for removal and (11, chapter 35-21-41, section 35-21-41-400-001) for installation.

   (c) Removal/installation of infill (filler) panels per (11, chapter 25-25-11, section 25-25-11-000-001) for removal and (11, chapter 35-21-41, section 25-25-11-400-001) for installation. Use clip of P/N DAN255A05 (as required) to clamp consecutive infill panels together.

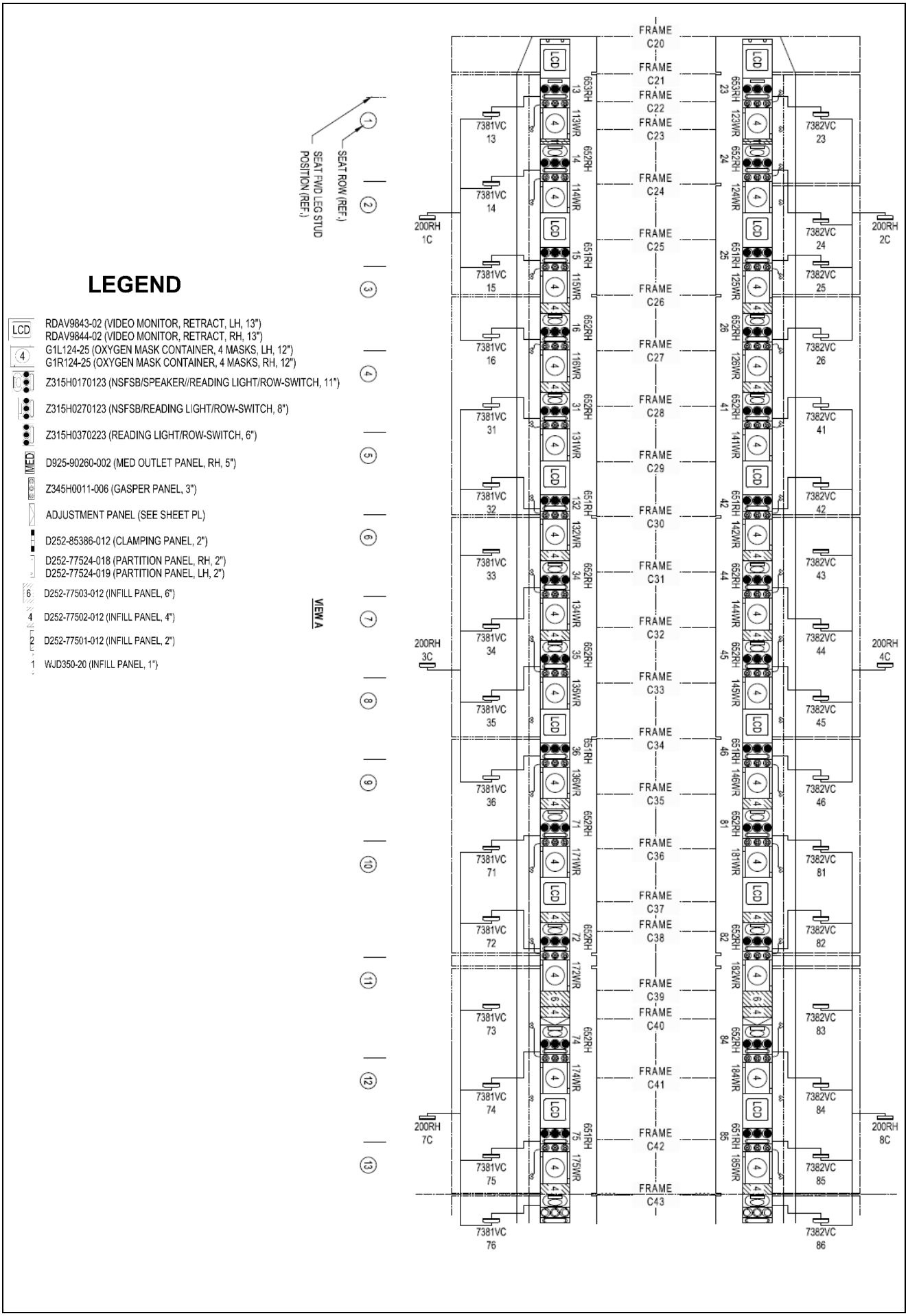
   (d) PSU cable connections must be tied with cable tie P/N NSA935401-03.
2. Ensure transport-safety-device has been removed prior installation of O_2-boxes.
3. Ensure oxygen mask drop within the tolerance area defined in (11, chapter 35-21-41, section 35-21-41-991-00300-a) and in this drawing.
4. Pay special attention to the orientation of the oxygen generator inside the oxygen box to provide the adequate mask drop shown in the drawing.
5. Perform oxygen mask drop ground test per (11, chapter 35-21-00).
6. Video monitor (retractable) connection must be kept as in previous installation. Exchange cable harness as required.
7. Final position of PSU panels shall be sanctioned and approved by the quality control departments and it is subjected to acceptance during the engineering compliance inspection.



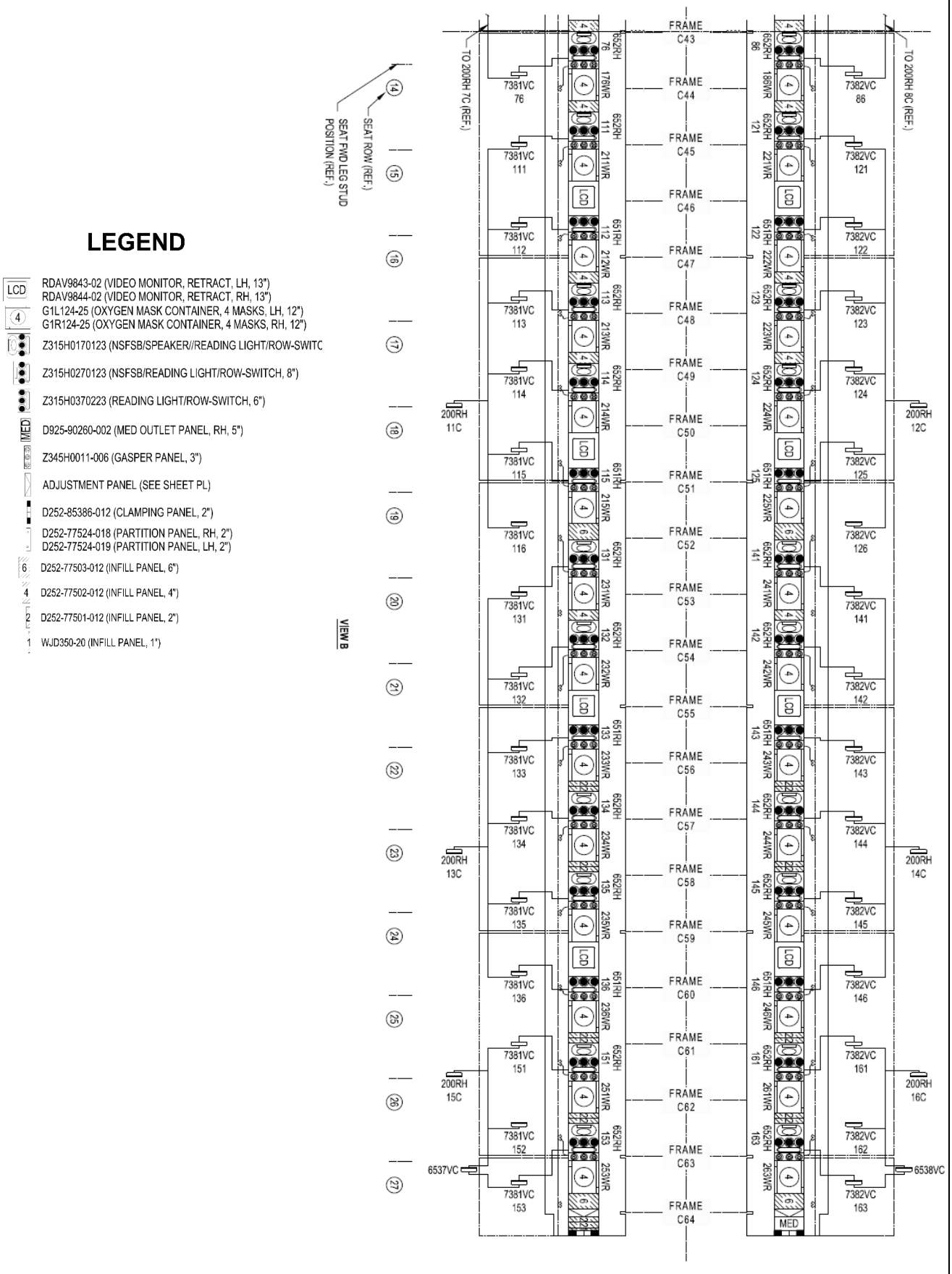
DWG02-1: PSU Locations (rows 1-13).



DWG02-2: PSU Locations (rows 14-27).



DWG02-3: PSU Locations (rows 1-13).

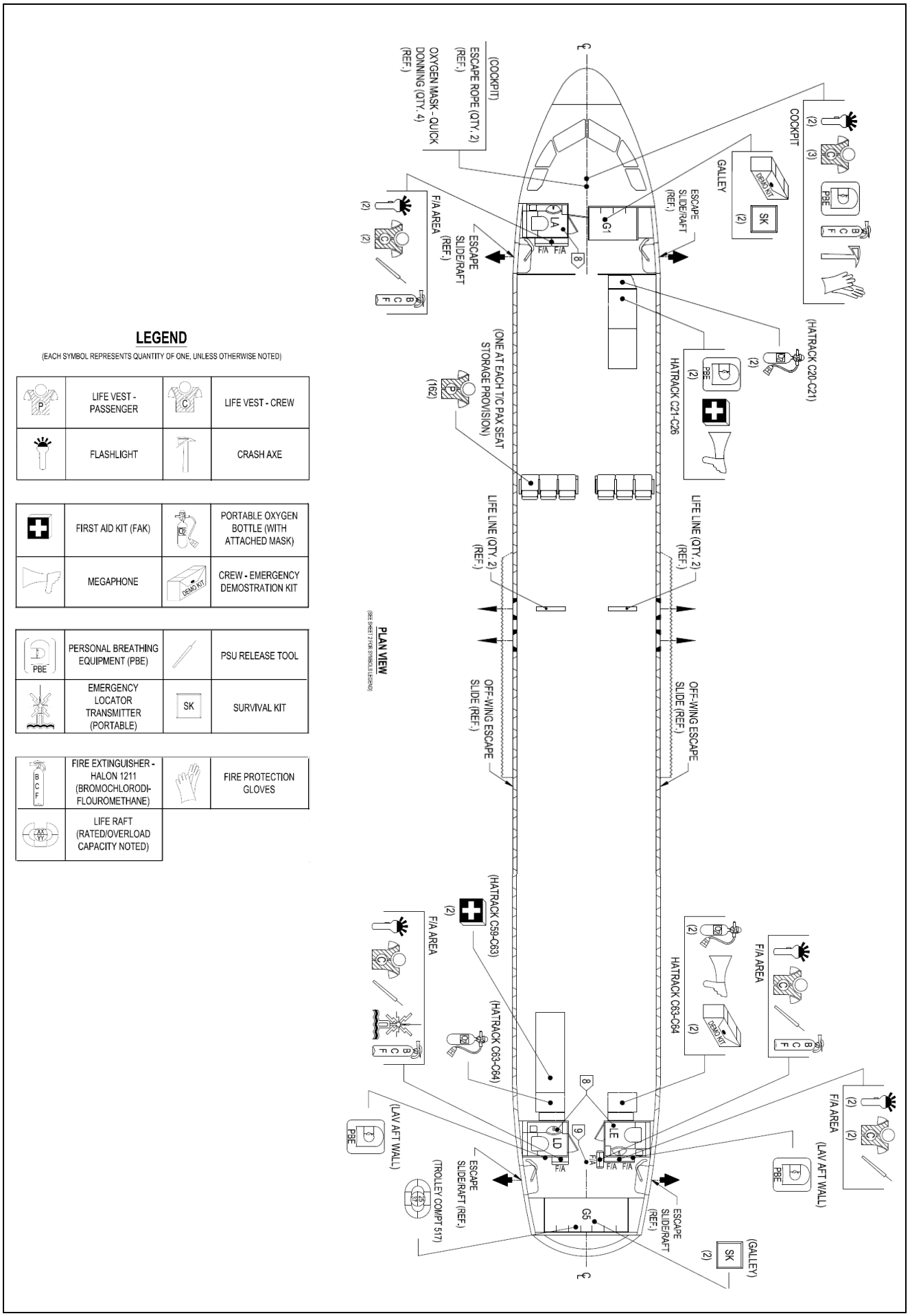


DWG02-4: PSU Details (rows 14-27).

7.3 Emergency Equipment Location Diagram

This section gives information about the new emergency equipment items location. In order to provide with all the necessary information, a drawing, DWG03, is presented bellow. The following notes refer to DWG03 and must be carefully read in order to completely understand information shown in the drawing. Take into account that FL prefix on note numbers below indicates drawing flag note.

1. It is the responsibility of the aircraft operator to ensure compliance with all emergency equipment requirements for their particular operations.
2. All emergency equipment removable items are indicated in DWG03 (see section 7.3) and identified in the legend therein by symbols, all emergency equipment fixed items, miscellaneous equipment or aircraft equipment items are called out in the drawing using their corresponding nomenclature.
3. All emergency equipment must be readily accessible and protected from inadvertent damage.
4. All emergency equipment locations must be conspicuously placarded. Use arrow-signs, as needed, to indicate the emergency equipment stowage locations.
5. Emergency equipment location placards must be located as close to eye level as practical.
6. Ensure curtains/doors do not block access to, or markings of, emergency equipment.
7. Each portable oxygen bottle must have one oxygen mask connected to the dispensing terminal.
8. (FL) Each lavatory must be fitted with an approved smoke detector and automatic fire extinguisher serving the trash bin.
9. (FL) Check that ELT of P/N 01N65900 is fixed at frame c66.
10. Emergency evacuation slides must be approved as Type I under TSO-C69. Life rafts must be approved under TSO-C70.
11. Life vest must be approved under TSO-C13.
12. Seat belts must be approved under TSO-C22.
13. Crew torso restrain belts must be approved under TSO-C114.
14. PBE must be approved under TSO-C99 or C-116.
15. For FAR 121 operations: the first aid kits, emergency medical kits and automated defibrillators must meet the requirements of FAR 121.803, see (28).
16. The installation of all items called out herein must be shown to comply with (19, Paragraph 25.789(a)), "retention of items of mass in passenger and crew compartments [and galleys]."
17. Final position of emergency equipment and related placards shall be sanctioned and approved by the quality control department and it is subjected to acceptance during an engineering compliance inspection.

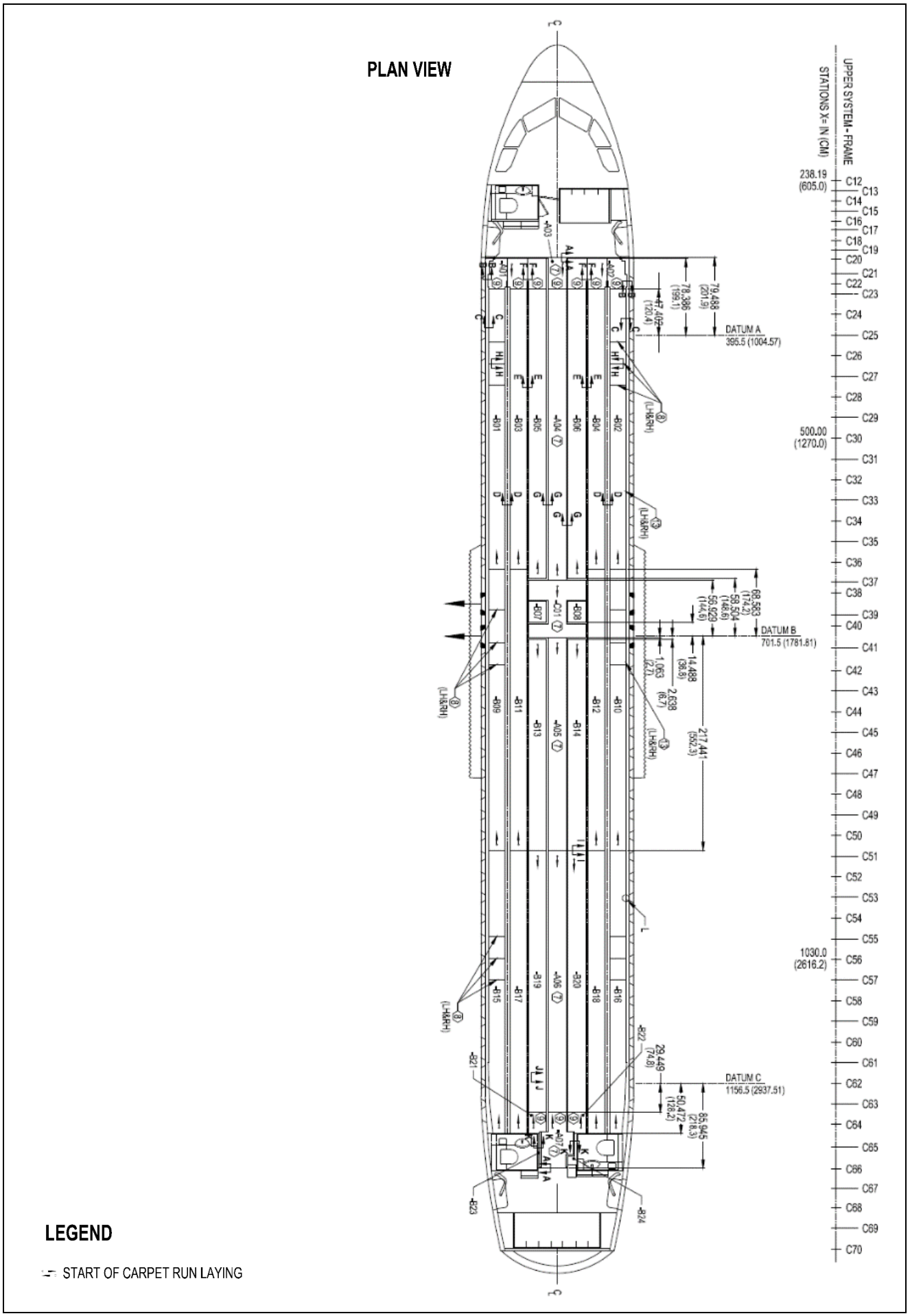


DWG03: Emergency Equipment

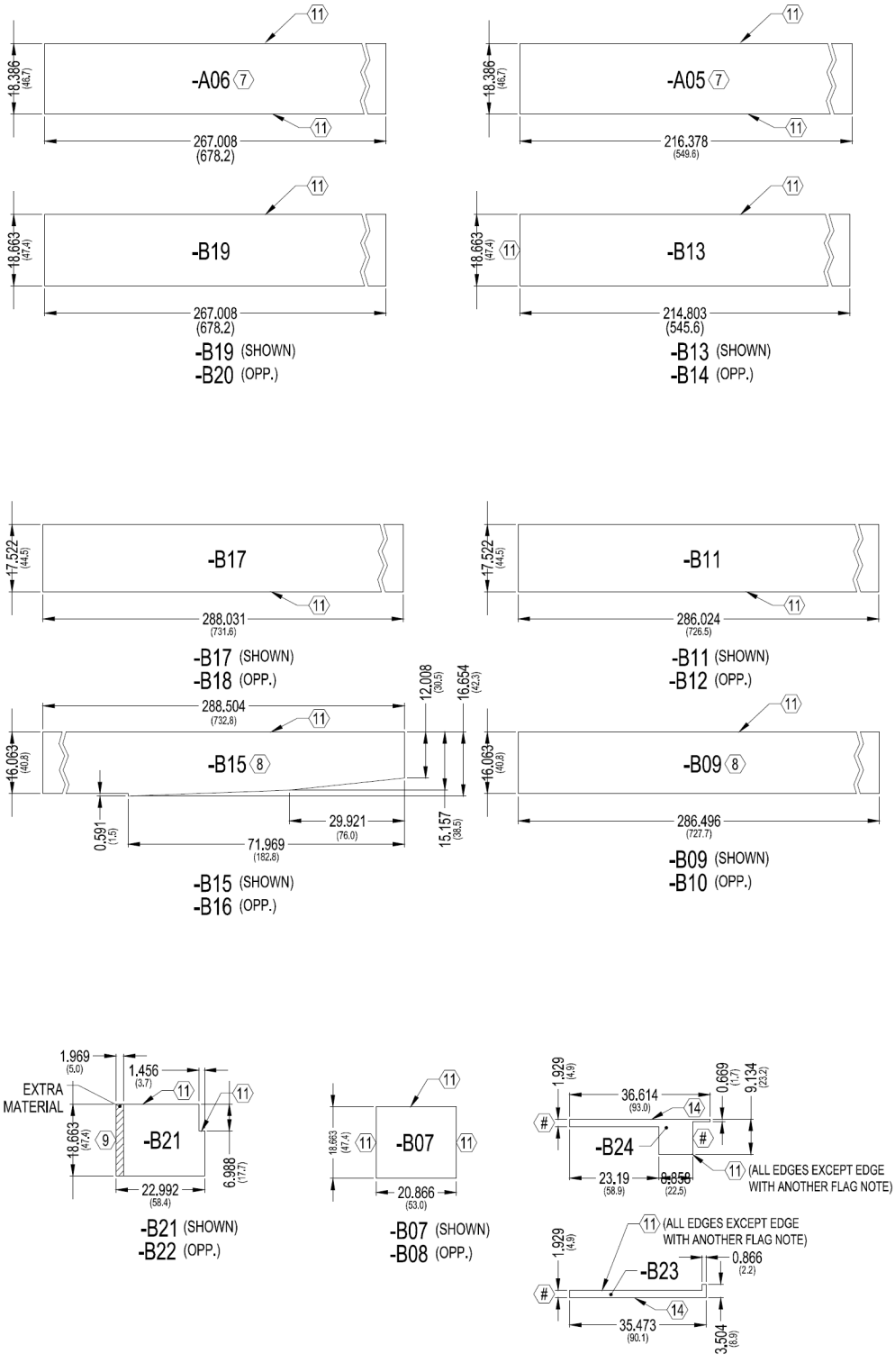
7.4 Floor Covering Layout

This section explains the resultant configuration of floor coverings. In order to do that, a set of four drawings, DWG04-X (where "X" goes from 1 to 4), is presented bellow and the following notes refer to those drawings:

1. The following notes must be carefully read in order to completely understand DWG04-X, shown bellow.
2. FL prefix on note numbers below indicates drawing flag note.
3. For carpet removal and installation instructions refer to (11, chapter 25-28-41).
4. Flammability test for carpets must be certified to meet requirements of (19, Paragraph 25.853 (a)).
5. Serge with Airbus yarn material P/N ABS5678AD41-17.
6. Carpet outlines, sheets and cut-outs have to be secured by adhesive tape as per (16, Specification 80-T-39-1023).
   Clearance between tape strips to be max 11.81 inches (30.0 cm) except as noted in flag note 7.
7. (FL) In area of trolley tracks, adhesive tape have to be bounded in a distance of max 3.94 inches (10.0 cm).
8. (FL) Cable routing under carpet (extra length of carpet is provided).
9. (FL) Carpet borders to be serged after matching.
10. All borders of carpet must be serged as shown in detail L, except those noted with flag notes 11 and 14.
11. (FL) Carpet edge not to be serged.
12. (FL) Effective to all carpet covered seat tracks.
13. (FL) Cuts to be made on assembly; carpet in between must be bent up.
14. (FL) Carpet have to be serged without using serging tape.
15. Serging in area of raceway have to be removed as required on assembly.
16. All seat track joint should be sealed with DAN1186 sealant as per (16, Specification 80-T-34-9600).
17. Run carpet laying as shown in drawing DWG04, shown bellow.
18. For original carpet installation refer to (14).

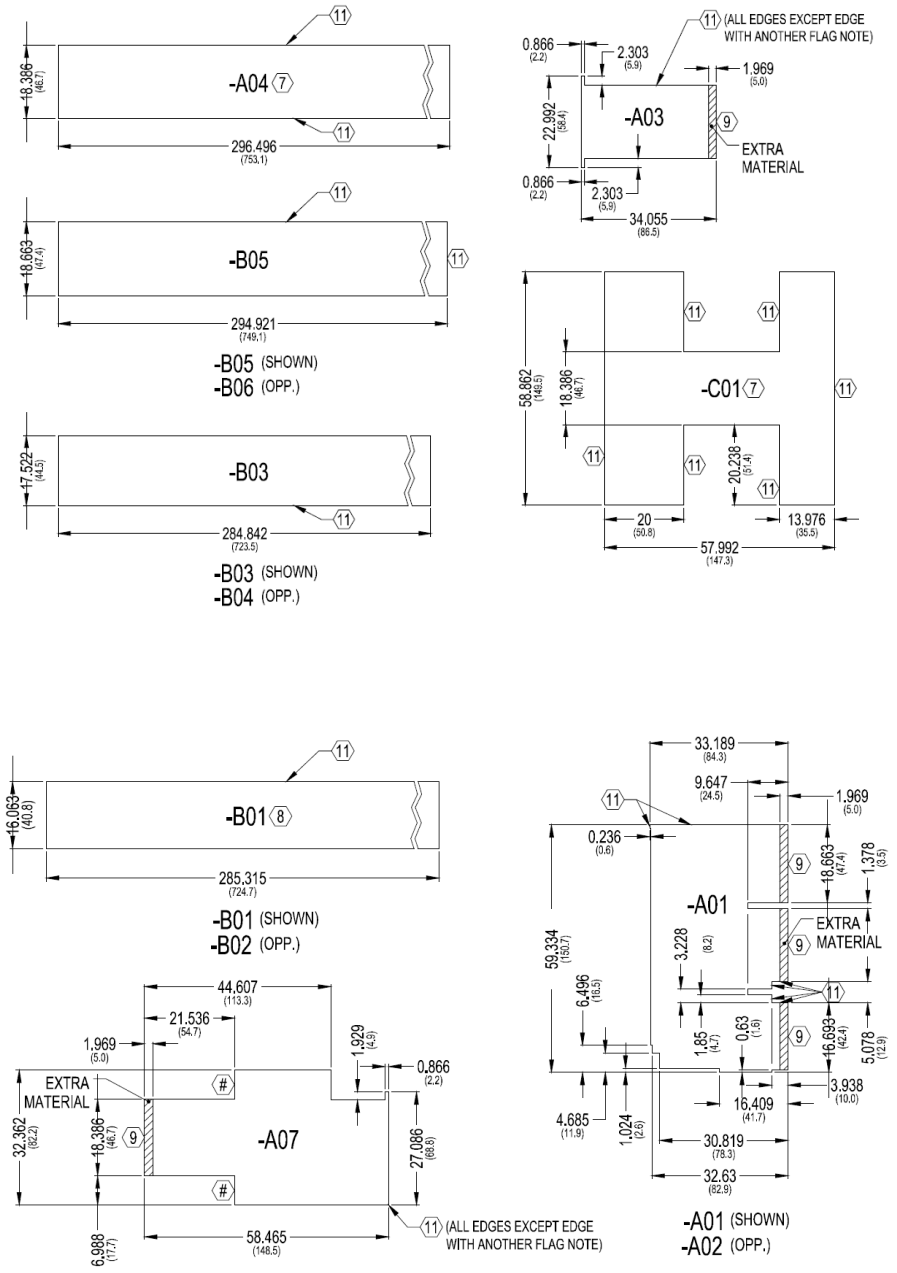


DWG04-1: Floor Covering Layout.



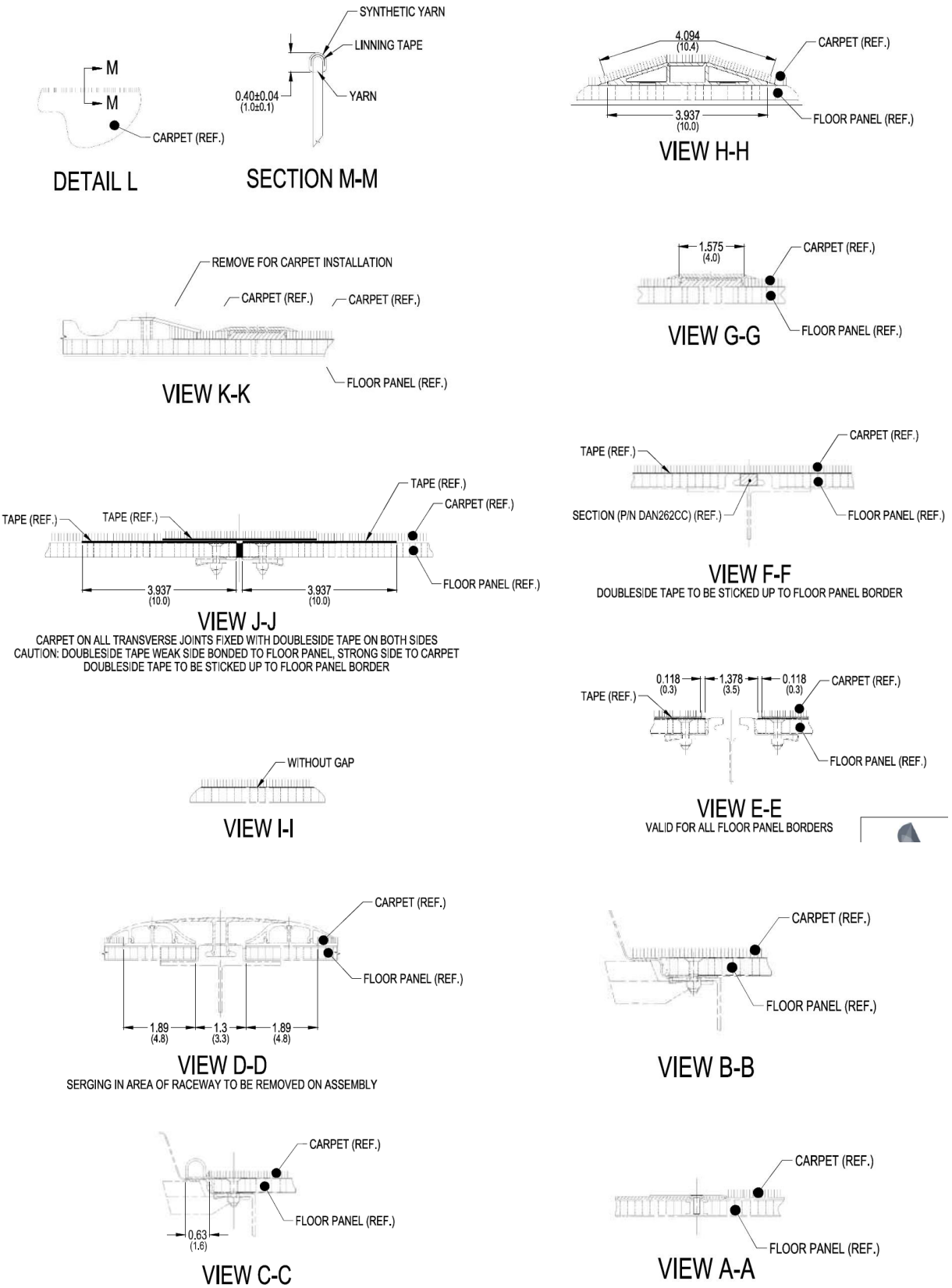
NOTES:
DIMENSIONS ARE IN INCHES (CENTIMETERS)
CARPET BORDER TO BE SERGED

DWG04-2: Carpet Sections



NOTES:
DIMENSIONS ARE IN INCHES (CENTIMETERS)
CARPET BORDER TO BE SERGED

DWG04-3: Carpet Sections 2.

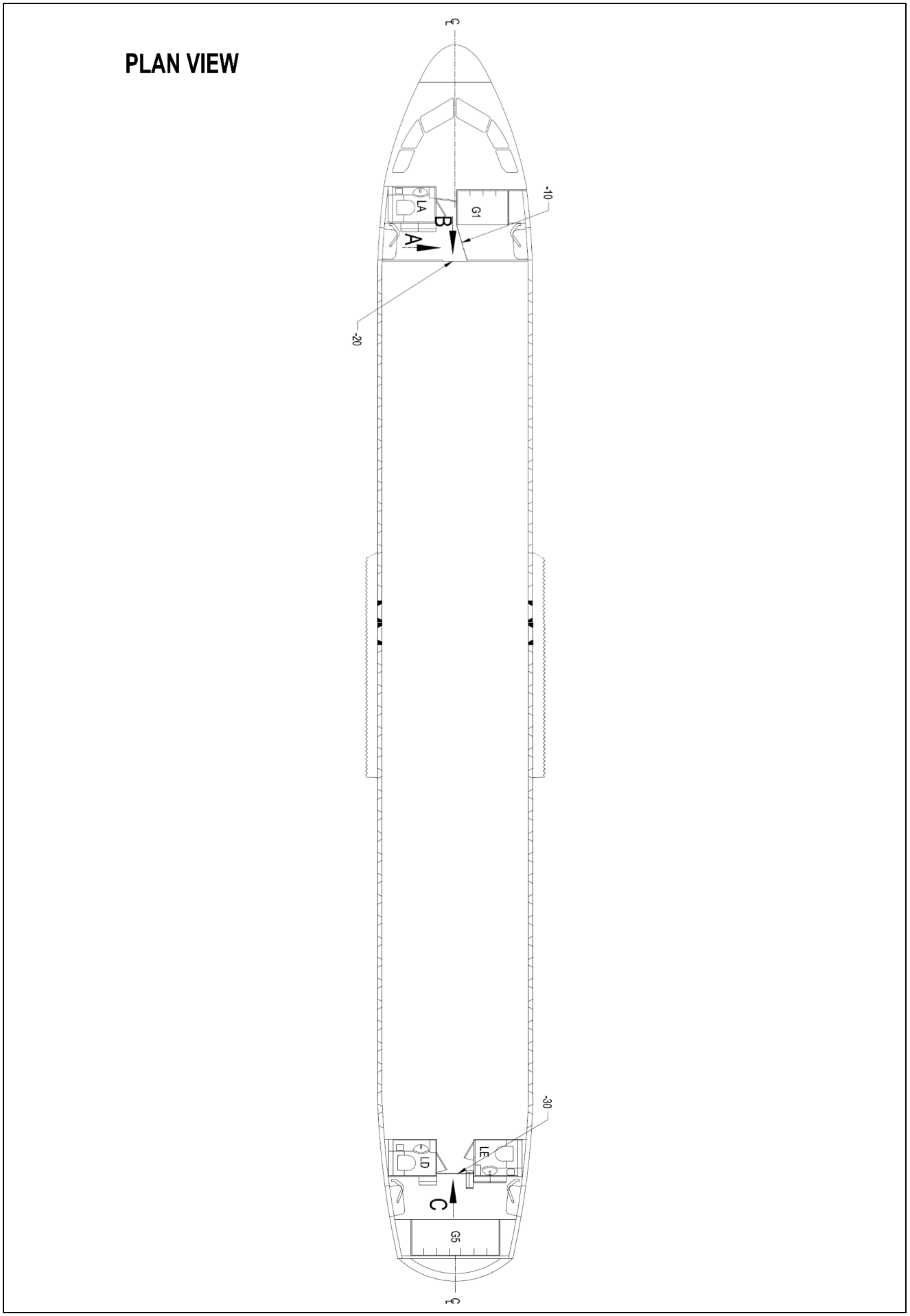


DWG04-4: Carpet Installation.

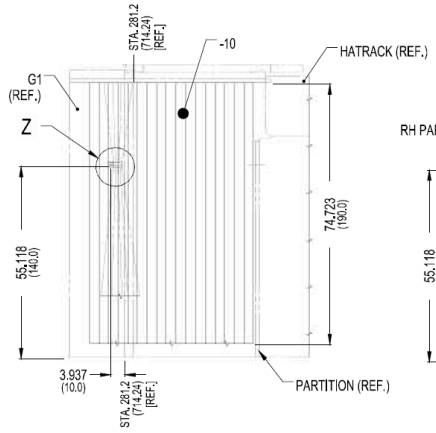
7.5 Curtain Installation

This section explains the resultant configuration of curtains and helps with the installation instructions. For that, a set of two drawings, DWG05-X (where "X" takes the values 1 and 2), is included bellow.
The following notes refer to DWG05-X and must be carefully read in order to completely understand it:

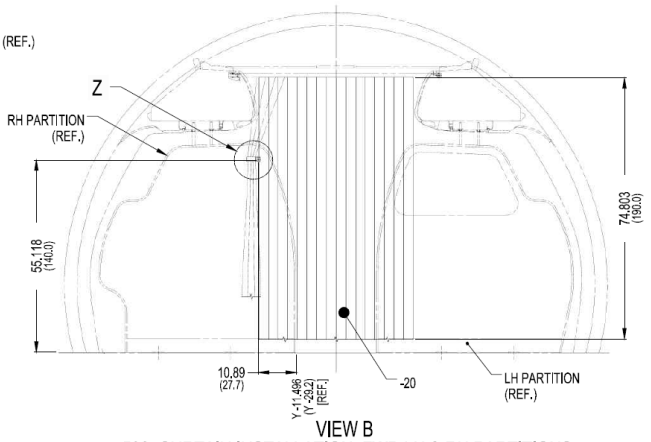
1. For curtain removal and installation instructions refer to (11, chapter 25-26-41).
2. Flammability test for curtains must be certified to meet requirements of (19, Paragraph 25.853 (a)).
3. Seam with yarn material P/N D524218-35962 (alternative P/N ABS5677AB40-2 of Airbus).
4. Distance between glider must be 2.76 inches (7.0 cm).
5. For original curtain installation refer to (13).



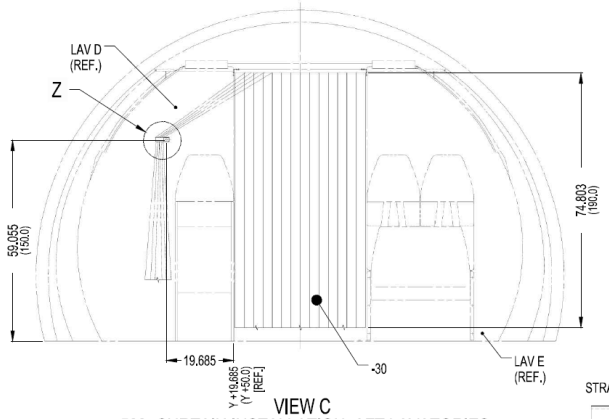
DWG05-1: Curtains Location.



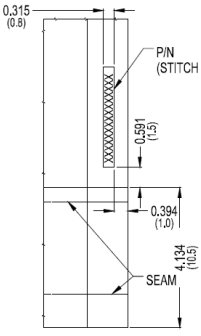
VIEW A
-501: CURTAIN INSTALLATION, G1 & FWD RH PARTITION



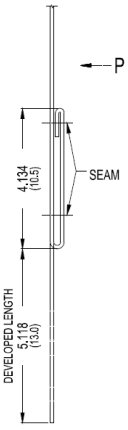
VIEW B
-502: CURTAIN INSTALLATION, FWD LH & RH PARTITIONS



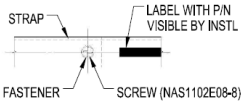
VIEW C
-503: CURTAIN INSTALLATION, AFT LAVATORIES



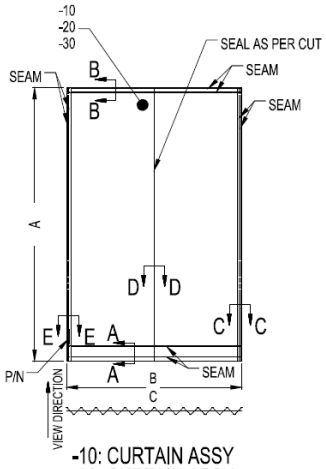
VIEW P
(SCALE: NONE)



SECTION A-A
(SCALE: NONE)



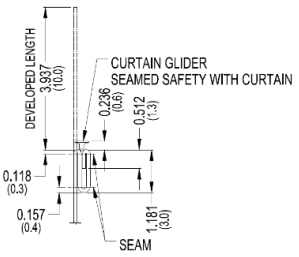
DETAIL Z



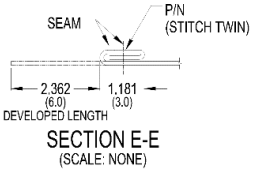
-10: CURTAIN ASSY
-20: CURTAIN ASSY
-30: CURTAIN ASSY
DRAWED WITHOUT GLIDER

A +0 -1.394 (+0 -7.0)	B ±1.969 (±5.0)	C ±1.969 (±5.0)	CURTAIN DASH Nº
74.803 (190.0)	55.118 (140.0)	93.701 (238.0)	-10
74.803 (190.0)	46.063 (117.0)	77.165 (196.0)	-20
74.803 (190.0)	39.370 (100.0)	66.142 (168.0)	-30

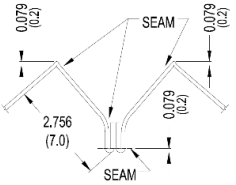
DIMENSION B = FINISHED SIZE



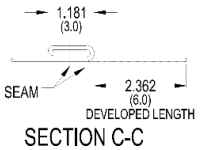
SECTION B-B
(SCALE: NONE)



SECTION E-E
(SCALE: NONE)



SECTION D-D
(SCALE: NONE)



SECTION C-C
(SCALE: NONE)

NOTES:
DIMENSIONS ARE IN INCHES (CENTIMETERS)

DWG05-2: Curtains Installation.

8 Certification regulations.

When a modification is performed, it is necessary to certify it in order to comply with EASA's airworthiness regulations. In this section, it is going to be analyzed the certification of the project as if it were carried out by Sirium Aerotech standards.

8.1 Design Organization Approval

Sirium Aerotech is certified as an EASA DOA (ID. 21J.523) which also works with FAA approvals of interiors, avionics and structures. It warrants the airworthiness of its products by STCs or minor modifications.

To understand better what a DOA is, it is useful to read the definition provided in (20):

"A DOA is the recognition given by EASA that a Design Organization complies with the requirements of Part 21 Subpart J.

The approval includes terms defining:

1. **Scope of approval:** The type of design activities including fields of expertise categories of products. The applicable products can be Large Aeroplanes, Engines, Small Rotorcraft, Sailplanes, etc.
2. **List of products:** The list of products for which the DOA holder is Type Certificate applicant or holder (if applicable).
3. **Privileges:** A DOA holder can
   (a) Perform design activities within the scope of approval.
   (b) Have compliance documents accepted by the Agency without further verification.
   (c) Perform activities independently from the Agency.
4. **Limitations:** Any limitations on the above."

On the other hand, the implementing rules for the airworthiness and environmental certification of aircraft and related products that a DOA organization must comply with are explained in the following document. Take a look for better understanding:

EASA Comission Regulation No. 748/2012 of 3 August 2012

8.2 Documentation

The documents of each project are divided into two sets:
The first group is composed of the documents given do the client, containing instructions for the aircraft modification and maintenance, as well as the signatures of the project. The second group consist of the compliance documents required by EASA. Figure bellow shows an schematic classification of these documents into a DOA project:

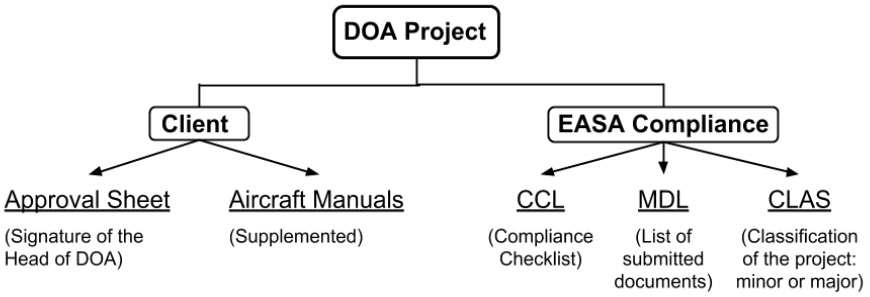


Figure 6: Classification of documents.

On the one hand, client documents consist of the APRB containing the signature of the Head of the company, the CB containing all the information given in sections 2 - list of materials - and 4 - accomplishment instructions-, the MFCT containing information shown in section 6 - manufacturing instructions - and finally the DWGs which summarizes all figures shown in section 7 - results-.

On the other hand, EASA compliance documents are going to be deeply explained in sections below.

8.2.1 Compliance Checklist - CCL

The CCL is an EASA compliance document whose purpose is to establish the certification basis of the modification and its affected paragraphs, as well as establishing the AMC for each paragraph and defining the documents where compliance will be shown for every paragraph.

Let's see the following definition of AMC that can be found at (22):

"AMCs are non-binding standards adopted by EASA to illustrate means to establish compliance with the Basic Regulation and its Implementing Rules.
The AMCs issued by EASA are not of a legislative nature. They cannot create additional obligations on the regulated persons, who may decide to show compliance with the applicable requirements using other means. However, as the legislator wanted such material to provide for legal certainty and to contribute to uniform implementation, it provided the AMC adopted by EASA with a presumption of compliance with the rules, so that it commits competent authorities to recognise regulated persons complying with EASA AMC as complying with the law."

Now, in order to complement the definition given above, the following table shows a list and classification of MCs:

Compliance	Means of Compliance	Associated compliance docs.
Engineering Evaluation	MC0: Compliance Statement -Reference to Type Design Docs. -Election of Methods, factors... -Definitions	Type Design Documents Recorded Statements.
	MC1: Design Review	Description, Drawings
	MC2: Calculation/Analysis	Subsanation Reports
	MC3: Safety Assessment	Safety Analysis
Tests	MC4: Laboratory Tests	Test Programs, Reports and Interpretation
	MC5: Ground Tests on related product	
	MC6: Flight Tests	
	MC8: Simulation	
Inspection	MC7: Design Inspection/Audit	Inspection or Audit Reports
Equipment Qualification	MC9: Equipment Qualification	Note: Equipment qualification may include all previous means of compliance

Table 17: Means of Compliance Classification

1. **Certification Basis**

   In this section TCDS is analyzed, which, according to (29), it is a document that records the type certification data of a product that should also be available in the flight or maintenance manuals. Some data that can be found in the TCDS are, for example, control surface movement limits, operating limitations, placards and weight and balance.

   The certification basis for a change to a type certificated aircraft, engine or propeller consists of the regulations mentioned in the TCDS or the applicable regulations in effect on the date of the application.
   The certification basis can vary depending on the magnitude and scope of the change, so the classification of the design change is necessary to determine whether the existing type certification basis is adequate for approval of the change, or whether the latest version of the requirements must be used.

   On the other hand, a TC signifies the airworthiness of a particular category of aircraft, according to its manufacturing design.

   For this project, modification is applied to the A320-233 aircraft MSN 3672, so the TCDS applicable in this case is (4). Looking on this document, the certification basis and special conditions can be found:

   - **Original Aircraft Certification Basis:** corresponds with JAR 25* Change 11 (18), as it can be found on (4, section 1.II, subsection 4.1):

     "The applicable technical conditions for models A320-211, A320-212, A320-231 and weight variants up to 006 (where "Sharklet" versions A320-214,-215,-216,-232,-233 are

included) are defined as follows:

- JAR 25 Change 11 (except paragraph 25.207 which remains at Change 10) as elected by the Manufacturer.

- A320 Special Conditions, Experience Related Conditions and Harmonization Conditions."

*Note that part 25 refers to large airplanes.

- **Special conditions**: they rose to cover novel or unusual features not addressed by the JAR.

  According to (4, section 1.II, subsection 5.6), the following special condition has to be taken into account:

  SC-D-0306 – Heat release and smoke density requirements to seat material.
  In an attempt to comply, (6) will be considered.

It must be taken into account that the environmental characteristics of the product are not affected by this project.

2. **Affected Paragraphs**

Although Certification Basis for the airplane of the project corresponds with (18), on an elect to comply, Certification Basis (19) will be used, excepting the paragraph 25.562; in that particular item (18) will be used to comply.

In order to understand why for this particular case (19) cannot be used to comply, it is interesting to read paragraphs 25.561 and 25.562 of this document, which refer to Emergency Landing Conditions:

"**JAR 25.561 General**

(a) The aeroplane, although it may be damaged in emergency landing conditions on land or water, must be designed as prescribed in this paragraph to protect each occupant under those conditions.

(b) The structure must be designed to give each occupant every reasonable chance of escaping serious injury in a minor crash landing when—

1. Proper use is made of seats, belts, and all other safety design provisions;

2. The wheels are retracted (where applicable); and

3. The occupant experiences the following ultimate inertia forces acting separately relative to the surrounding structure:

(i) Upward, 3.0g

(ii) Forward, 9.0g

(iii) Sideward, 3.0g on the airframe and 4.0g on the seats and their attachments

(iv) Downward, 6.0g

(v) Rearward, l.5g

(c) Equipment, cargo in the passenger compartment and other large masses must be positioned so that if they break loose they will be unlikely to—

1. Cause direct injury to occupants;

2. Penetrate fuel tanks or lines or cause fire or explosion hazard by damage to adjacent systems; or

3. Nullify any of the escape facilities provided for use after an emergency landing. When such positioning is not practical (e.g. fuselage mounted engines or auxiliary power units) each such item of mass shall be restrained under all loads up to those specified in JAR 25.561(b).
If the local attachments for these items are subject to severe wear and tear, these attachments should be designed to withstand 1.33 times the specified loads.

(d) Seats and items of mass (and their support- ing structure) must not deform under any loads up to those specified in sub-paragraph (b)(3) of this paragraph in any manner that would impede subsequent rapid evacuation of occupants. (See ACJ 25.561(d).)."

"**JAR 25.562 Emergency landing dynamic conditions**

(a) The seat and restraint system in the aeroplane must be designed as prescribed in this paragraph to protect each occupant during an emergency landing condition when —

1. Proper use is made of seats, safety belts, and shoulder harnesses provided for in the design; and

2. The occupant is exposed to loads resulting from the conditions prescribed in this paragraph.

(b) Each seat type design approved for passenger occupancy must successfully complete dynamic tests or be demonstrated by rational analysis based on dynamic tests of a similar type seat, in accordance with each of the following emergency landing conditions. The tests must be conducted with an occupant simulated by a 170-pound (77.11 kg) anthropomorphic, test dummy sitting in The normal upright position.

1. A change in downward vertical velocity, ($\triangle V$) of not less than 35 feet per second (10.67 m/s), with the aeroplane's longitudinal axis canted downward 30 degrees with respect to the horizontal plane and with the wings level. Peak floor deceleration must occur in not more than 0.08 seconds after impact and must reach a minimum of 14g.

2. A change in forward longitudinal velocity ($\triangle V$) of not less than 44 feet per second (13.41 m/s), with the aeroplane's longitudinal axis horizontal and yawed 10 degrees either right or left, whichever would cause the greatest likelihood of the upper torso restraint system (where installed) moving off the occupant's shoulder, and with the wings level. Peak floor deceleration must occur in not more than 0.09 seconds after impact and must reach a minimum of 16g. Where floor rails or floor fittings are used to attach the seating devices to the test fixture, the rails or fittings must be misaligned with respect to the adjacent set of rails or fittings by at least 10 degrees vertically (i.e. out of parallel) with one rolled 10 degrees.

(c) The following performance measures must not be exceeded during the dynamic tests conducted in accordance with sub-paragraph (b) of this paragraph:

1. Where upper torso straps are used tension loads in individual straps must not exceed 1750 pounds (793.78 kg). If dual straps are used for restraining the upper torso, the total strap tension loads must not exceed 2000 pounds (907.18 kg).

2. The maximum compressive load measured between the pelvis and the lumbar column of the anthropomorphic dummy must not exceed 1500 pounds (680.38 kg).

3. The upper torso restraint straps (where installed) must remain on the occupant's shoulder during the impact.

4. The lap safety belt must remain on the occupant's pelvis during the impact.

5. Each occupant must be protected from serious head injury under the conditions prescribed in sub-paragraph (b) of this paragraph. Where head contact with seats or other structure can occur, protection must be provided so that the head impact does not exceed a Head Injury Criterion (HIC) of 1000 units. The level of HIC is defined by the equation -

$$HIC = (t_2 - t_1)[\frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} a(t)dt]_{max}^{2.5} \quad (1)$$

Where -

t_1 is the initial integration time,

t_2 is the final integration time, and

a(t) is the total acceleration vs. time curve for the head strike, and where

(t) is in seconds, and (a) is in units of gravity (g).

3. Where leg injuries may result from contact with seats or other structure, protection must be provided to prevent axially compressive loads exceeding 2250 pounds (1020.58 kg) in each femur.

4. The seat must remain attached at all points of attachment, although the structure may have yield.

5. Seats must not yield under the tests specified in sub-paragraphs (b)(1) and (b)(2) of this paragraph to the extent they would impede rapid evacuation of the aeroplane occupants."

When the Certification Basis of an airplane corresponds with (19) and meets the 9g dynamic requirements of Paragraph 25.562, it can be considered as a 16g seats airplane. This category is defined by (30) as follows:

"16g is an airplane transport category in which seats must be tested by crash-testing in a manner that simulate the loads that could be expected in an impact-survivable accident where the highest load factor is in the forward direction at 16 g's (...). For this test, deceleration must go from a minimum of 44ft/sec to 0 ft/sec in not more than 0.09 seconds with a peak deceleration of at least 16g's."

On the other hand, 9g seat transport category is considered when Paragraph 25.562 does not apply; it means, when Certification Basis is different from (19). In the particular case of this project, original Certification Basis is (18), so it is possible to conclude that **our airplane is considered as 9g**, that is why concretely for this paragraph we are not going to use (19) to comply.
This kind of seats follow a static pull test and installation approval process is easier than 16g process, since most of the occupant protection criteria needed before is not required in this case.

Differentiation between 16g and 9g seats is important when classifying the modification since modifications entailing 16g seats change are usually considered as major while, in the other cases, are considered as minor.

Now that all this introductory information is clear, the affected paragraphs, which can be found at (19), will be listed and completed with a briefly explanation for compliance:

- **JAR 25.305 - Strength and deformation - MC9 (see table 17):**

  162 pax configuration is allowed in document (4). Seat comply with TSO C-127, as established in (10).

- **JAR 25.307 - Proof of structure - MC9:**

  162 pax configuration is allowed in in document (4). Seat comply with TSO C-127, as established in (10).

- **JAR 25.561 - EMERGENCY LANDING CONDITIONS: General - MC9:**

  Seats are TSO approved, as established in (10). Attachment is performed according to (11).

- **JAR 25.603 - Material - MC1:**

  No new seats are installed; two rows are removed and the rest of seats relocated.
  PSU/Spacers and life vests are the original installed in the A/C.
  Carpet material has been tested in section 5 according to (19, paragraph 25.853 (b)), which states that materials must be self-extinguishing when tested vertically.

- **JAR 25.607 - Fasteners - MC1:**

  The fasteners used are the same type previously installed and are considered approved.

- **JAR 25.783 - Fuselage doors - MC0:**

  This modification does not affect to any fuselage door.

- **JAR 25.785 - Seats, berths, safety belts and harnesses - MC1:**

  Seats placed in the A/C (P/N 3510A, type 380 series) are TSO C-127a approved, as established in (10). All seat belts and torso restraint systems installed by performing

the modification are the original components and are not modified; they are previously considered approved.

- **JAR 25.787 - Stowage compartments - MC0:**

  No change on stowage compartments

- **JAR 25.789 - Retention of items of mass in passenger and crew compartments and galleys - MC0:**

  The modification does not affect or modify the items shown in this paragraph. They are the original ones and are considered approved.

- **JAR 25.791 - Passenger information signs and placards - MC1:**

  In DWG03 (see section 7.3) it is specified that all emergency equipment must be conspicuously placarded. The same is specified for setting row placards.

- **JAR 25.793 - Floor surfaces - MC1:**

  The carpets installed have slip resistant properties.

- **JAR 25.803 - Emergency evacuation - MC1:**

  162 pax configuration is allowed by document (4). The project consists in the reduction of passengers accommodated. Pitch between seats remain as before or is increased. Emergency evacuation is not adversely affected as shown in section 7.1 (DWG01).

- **JAR 25.807 - Emergency exits - MC0:**

  This modification does not affect to any emergency exit.

- **JAR 25.809 - Emergency exit arrangement - MC0:**

  This modification does not affect to any emergency exit.

- **JAR 25.811 - Emergency exit marking - MC1:**

  No change on placard and markings is performed. The floor proximity emergency escape path marking system is not blocked by the seats in the new positions, as demanded in section 7.1 (see DWG01).

- **JAR 25.813 - Emergency exit access - MC1:**

  The projected opening of the exit provided is obstructed and there is interference in opening the exit, but the ESF (7) named in document (4) ensures the equivalent safety. The minimum unobstructed passageway width in the emergency exits is 13 inches (33 cm), as shown in DWG01 (see section 7.1, (4) and (5)).

- **JAR 25.815 - Width of aisle - MC1:**

  Width of aisle comply with requirement of this subparagraph as indicated in section 7.1, DWG01.

- **JAR 25.817 - Maximum number of seats abreast - MC1:**

  This modification does not alter the maximum number of seats abreast. It complies with this point having one passenger aisle and 2 seats abreast on each side of the aisle.

- **JAR 25.851 - Fire extinguishers - MC1:**

  New configuration has 4 extinguishers, more than the minimum of 3 set by this paragraph, subsection 1. It is shown in DWG03 of section 7.3.

- **JAR 25.853 - Compartment interiors - MC4:**

  Following materials are going to be installed in the aircraft:

  - Curtains made from raw material P/N 2759LS700

  - Carpets made from raw material P/N BWW69/2

  Both of them have been vertically tested during 12 seconds and successfully passed. Test exceeds the requirements demanded by original Certification Basis. See section 5, Vertical Test.

- **JAR 25.1301 - Function and Installation - MC9:**

  Seats are TSO C-127a compliant, as established in (10).
  Seats are the same as previously approved; this modification only rearrange them.
  PSUs are the same than the original installed before the modification.

- **JAR 25.1411 - SAFETY EQUIPMENT - General - MC1:**

  Safety equipment is relocated as per drawing DWG03 (see section 7.3).
  Safety equipment and stowage provisions are readily accessible.

- **JAR 25.1415 - Ditching Equipment - MC1:**

  The ditching equipment is the original.

- **JAR 25.1421 - Megaphones - MC1:**

  Two new megaphones are added as indicated in section 2.2, Material Needed. The megaphones are Airbus approved and installed according to (11)

- **JAR 25.1423 - Public Address System - MC1:**

  The public address system is modified by eliminating a quantity of PSU's named in section 3. The remaining PSU's are the original ones and are intelligible at all remaining

passenger seats as indicated in subsection 7.2. The rest of the components of the PA system are not modified and are already approved.

- **JAR 25.1519 - Weight, centre of gravity and weight distribution - MC1:**

  Once the installation has been performed the installer must carry out a weight and balance operation to amend the empty weight of the aircraft and the position of the centre of gravity. See subsection 3, Weight and Balance Study.

- **JAR 25.1541 - MARKING AND PLACARDS - General - MC1:**

  Row placards and emergency equipment placards are installed after the end of the modification.

- **SC-H1 - EWIS ICA - MC0:**

  Not affected. No wiring added. No EWIS ICA altered.

- **21.A.804 - EPA MARKING - MC1:**

  EPA marking is required in manufacturing instructions, as indicated in figure 5.

- **SC-D-0306 - Heat release and smoke density requirements to seat material. - MC0:**

  The special condition is not applicable as indicated in (5, section 4.b).
  In addition, the date of seat certification is previous than the date the SC is applicable, see (4) and (10).
  There is no change in seats, the project only modifies the lay-out, and the components installed are considered already approved.

8.2.2 Classification Assessment - CLAS

As stated by (31), "all deviations from an aircraft type design are "changes" that have to be approved by the authorities. Since these deviations can range from a simple correction to a massive structural intrusion, the EASA considers two kinds of changes: minor and major. Major modifications may be further classified as substantial, significant or not significant.

Classification of design changes is necessary to determine the appropriate approval method and the Certification Basis for the change. Thus, CLAS document tends to classify the project in a proper way.

Minor changes have no appreciable effect on the weight, balance, structural strength, reliability, operational characteristics, or other characteristics affecting the airworthiness of an aircraft, as well as the engine or propeller. Major changes are those ones not considered as minor.

On the other hand, a modification can be classified as substantial if is so extensive that a substantially complete investigation of compliance is required, and consequently a new TC."

The following tables show several basic and advanced questions that must be answered in order to classify the project:

A		YES	NO
1	The change/repair has an appreciable effect on weight.		X
2	The change/repair has an appreciable effect on balance.		X
3	The change/repair has an appreciable effect on structural strenght.		X
4	The change/repair has an appreciable effect on reliability.		X
5	The change/repair has an appreciable effect on operational characteristics of the product.		X

Table 18: Basic questions for project classification

B		YES	NO
1	The change/repair requires an adjustment of the TC basis (such as special condition, equivalent safety finding, elect to comply, exemption, reversion, later requirements).		X
2	The applicant proposes a new interpretation of the requirements used for the TC basis, that has not been published as AMC material or otherwise agreed with the Agency.		X
3	The demonstration of compliance uses methods that have not been previously accepted as appropriate for the nature of the change to the product or for similar changes to other products designed by the applicant.		X
4	The extent of new substantiation data necessary to comply with the applicable airworthiness requirements and the degree to which the original substantiation data has to be re-assessed and re-evaluated is considerable.		X
5	The change/repair alters the Airworthiness Limitations or the Operating Limitations.		X
6	The change is made mandatory by an airworthiness directive or the change is the terminating action of (8). Note: The design change previously classified minor and approved prior to the airworthiness directive issuance decision needs no re-classification. However, the Agency retains the right to review the change and re-classify/re-approve if found necessary.		X
7	The change introduces or affects functions where the failure effect is classified catastrophic or hazardous.		X
8	The associated change to (12) is major according to DOP-CLAS.		X
9	The repair requires a re-assessment and re-evaluation of the original certification substantiation data to ensure that the aircraft still complies with all the relevant requirements		X

Table 19: Advance questions for project classification

Once all the questions are asked, it is possible to conclude that this project is classified as a **minor modification**. Furthermore, affirmations below end up confirming the classification made:

- Project consists in a reduction of pax density, from 174 to 162. Seats are the same as previously installed. No new seat or monument is introduced.
- Emergency escape ability is not adversely altered.
- Airplane is certified as 9g since (19, paragraph 25.562) is not included in original certification basis.
- No other reason found to consider it major.

8.2.3 Master Data List - MDL

MDL document consist in a revision status list of all the documents generated for the modification project. It must specify the starting date of the project, the names and signature of the project designer and CVE of the company, as well as the P/N of the document and number of revisions.

In the case of our project, a list containing the following documents must be generated:

- Conversion Bulletin - CB
- Manufacturing Instructions - MFCT
- Drawings - DWG
- Test Plan - TP
- Test Report - TR
- Compliance Checklist - CCL
- Classification Assessment - CLAS
- Master Data List - MDL

8.2.4 Test Plan and Test Report - TP & TR

A document containing information shown in section 5 must be generated and divided into two parts:

The first part, known as TP, have to explain what a vertical test is and how is it going to be carried out. Second part, known as TR, consist in the results of the test performed.

9 Time organization and budget

This section analyzes the total time invested in the development of the project and the economic budget taking into account different factors.

9.1 Time organization

This project started at the end of January 2019 and was finished in mid June 2019 (a total amount of 135 days). The time dedicated was totally uniform: 4 hours and 30 minutes of work per day, without considering weekends and bank holidays.

Total work-hours = (135 total days - 36 weekend days - 9 bank holiday days) × 4h30' work/day;

Total work-hours = 400 h.

The total amount of hours spent in developing the project can be divided into five different tasks:

9.1.1 Analysis of the problem

The study and research of the background environment and state-of-the-art of the problem presented by the airline took a total amount of approximately 50 hours of work.

9.1.2 Design of the results

The design of the 13 drawings presented in the project by using the AutoCAD tool needed a total investment of time of approximately 88 work-hours.

9.1.3 Study of the regulatory framework

The complete study of the regulatory framework entailed the understanding of the TCDS corresponding to the aircraft of the project, the Certification Basis, special conditions together with the equivalent safety findings to solve them and the justification of the applicable paragraphs for compliance.
A total amount of 80 hours of work were dedicated to this task.

9.1.4 Accomplishment of flammability test

The approximate time it took to prepare the material samples and burners, perform the test and collect the results was 2 hours.

9.1.5 Report writing

Finally, writing the whole report was the task that took the longest, with a total amount of 180 hours of work.

9.1.6 Breakdown of the time study

The following table summarizes all the activities performed during the development of the project and its timing:

Task	Work-Hours
Analysis of the problem	50 h
Design of the results	88 h
Study of the regulatory framework	80 h
Flammability test	2 h
Report writing	180 h
TOTAL	**400 h**

Table 20: Total time of work.

9.2 Budget

In order to estimate the budget of this project, several factors need to be taken into account:

First of all, the time spent by the student when developing the project has to be considered and its cost is quantified in 5€ per hour, which is the salary received during the internship. This results in a total amount of 2000€.

Secondly, the equipment needed to perform the flammability test (machinery and burners) was already at Sirium Aerotech facilities and is valued at 2150€. Taking into account that this equipment has a 3 years depreciation, its cost would be of 2€ per day. Since it is only used for one day, it is possible to state that the money spent in the use of the flammability test equipment is 2€ that, together with the cost of buying the material samples (3€ per each) make a total amount of 8€.

Thirdly, it is considered the necessity of a computer with two screens valued at 1600€. Since this equipment has an 8 months depreciation, its cost per day would be 6.70€ and the total cost during the 90 days period that the project was being developed assumes a value of 603€.

Finally, costs of electricity have to be appraised. Knowing that the average cost of electricity is 0.10€/KWh and that Sirium Aerotech has an electricity contract that supplies 4.50 KW/h, a total amount of 180€ during the 400 hours spent in the project.

The following table summarizes the total budget of the project:

Item	Cost
Student work	2000€
Flammability test equipment	8€
Computer and screens	603€
Electricity costs	180€
TOTAL	**2791€**

Table 21: Budget of the project.

10 Conclusions and future work.

Throughout this project, it has been followed the objective of solving the engineering challenge proposed by an airline by applying the content learned along the university course, as well as all the certification and regulatory knowledge acquired during the internship at Sirium Aerotech.

It has been described all the necessary information required to carry out the engineering modification in order to satisfy the demands and needs of the contracting company.

Once the project is understood and finished, the following statements can be drawn:

1. The specific problem of the contracting airline has been analyzed and its socio-economic environment has been studied.
2. The resulting cabin layout configuration desired by the client has been designed and dimensioned by using the AutoCAD design tool.
3. All the instructions needed to carry out the modification and reach the desired results are provided and carefully explained.
4. A flammability test is performed to analyze the fire resistance of the raw materials chosen to manufacture carpets and curtains, and the corresponding manufacturing instructions are provided.
5. The regulatory framework of the project is studied and the modification is certified to comply with EASA standards.

To end up, it can be concluded that the requirements and needs of the client have been successfully met. From a personal point of view, it has been acquired a high knowledge in the sector of design and certification that, together with the learning obtained at university, led to a great professional development.

Looking to the future, new requirements of the airline may arise: new LOPA reconfiguration, change of the type of seats or even avionics modifications. In that case, the project will have to be updated and certified again, in accordance to the applicable regulations.

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